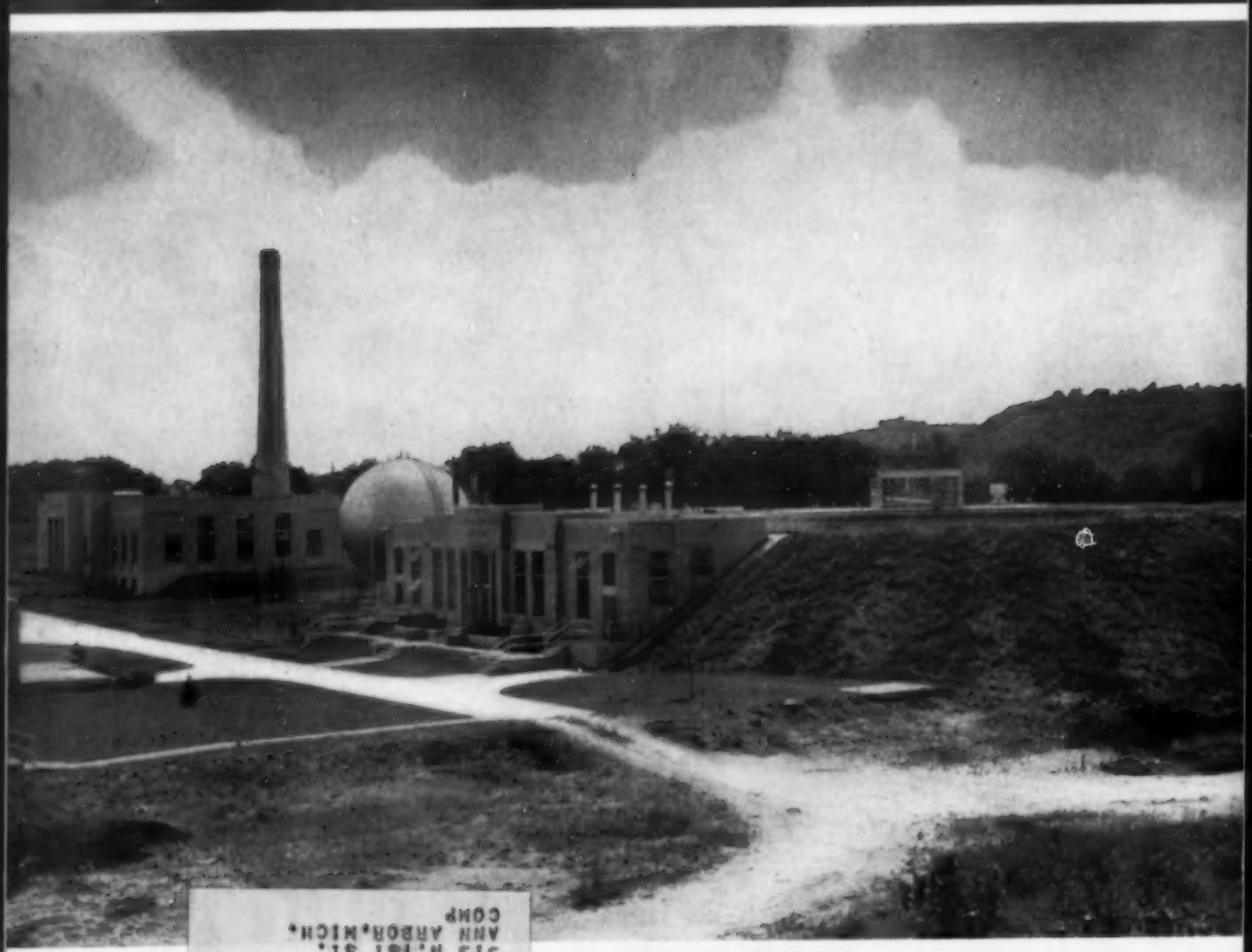
WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL



UNIVERSITY MICROFILMS
313 N. 1ST ST.
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COMP

Cincinnati's Mill Creek Sludge Digestion and Disposal Units

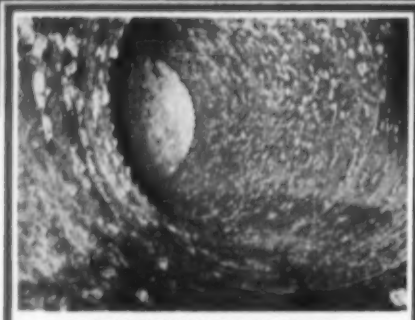
See "How to Avoid Sour Digesters", page 880

The Measurement of Flowing Water

A Critique on the Membrane Filter

SEPTEMBER 1955

Your city, too, can get hardening of the arteries



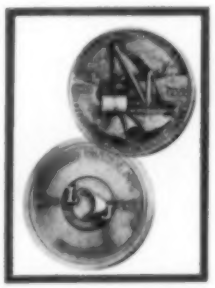
TUBERCULATION HAS SERIOUSLY REDUCED THE CAPACITY OF THIS PIPELINE.

TWENTY YEARS OF SERVICE HAVE NOT REDUCED THE ORIGINAL HIGH CARRYING CAPACITY OF THIS LOCK JOINT CONCRETE PIPELINE.

Water pipes, like blood vessels, can become congested and their efficiency seriously impaired by deposits on their inner walls. To avoid this "hardening of the arteries", far-sighted hydraulic experts insist on added protective linings for pipeline materials adversely affected by aggressive water.

Such costly protection is unnecessary in LOCK JOINT CONCRETE PRESSURE PIPE. The dense inner wall of this virtually ageless pipe is inherently immune to tuberculation, and consequently maintains its initial high carrying capacity *permanently*.

Its great durability and trouble-free service assure you the most economical and efficient pressure pipeline obtainable.

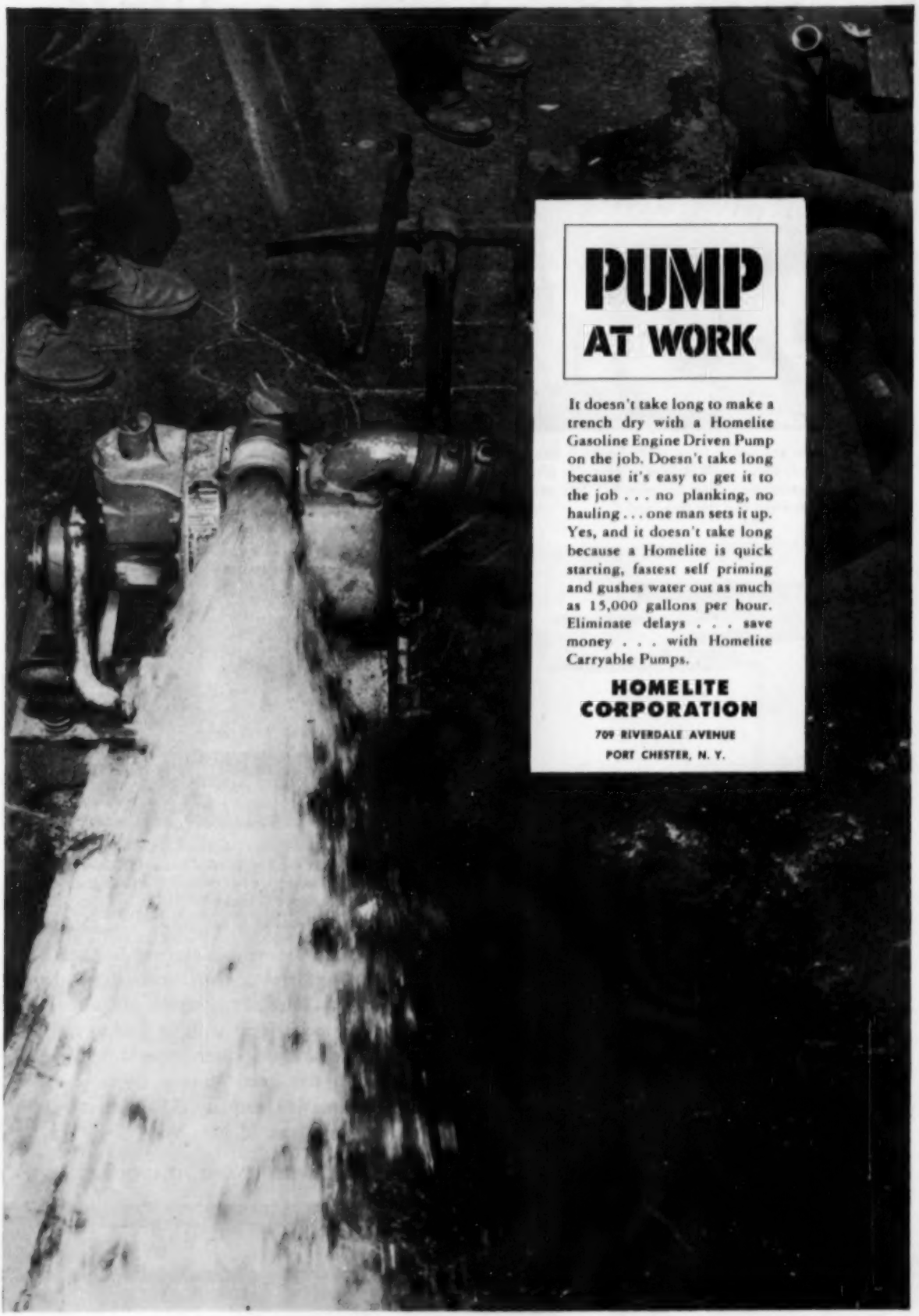


LOCK JOINT PIPE COMPANY

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous

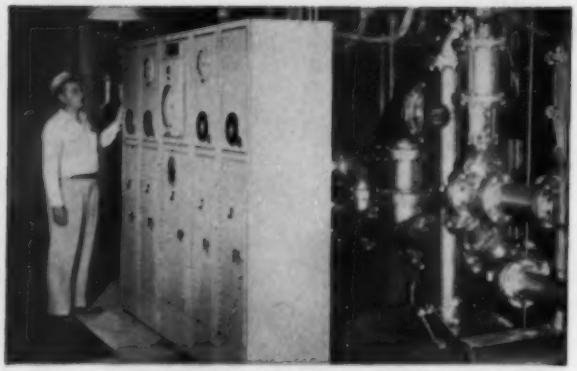

PUMP
AT WORK
It doesn't take long to make a trench dry with a Homelite Gasoline Engine Driven Pump on the job. Doesn't take long because it's easy to get it to the job . . . no planking, no hauling . . . one man sets it up. Yes, and it doesn't take long because a Homelite is quick starting, fastest self priming and gushes water out as much as 15,000 gallons per hour. Eliminate delays . . . save money . . . with Homelite Carryable Pumps.
HOMELITE CORPORATION
709 RIVERDALE AVENUE
PORT CHESTER, N. Y.

WATER

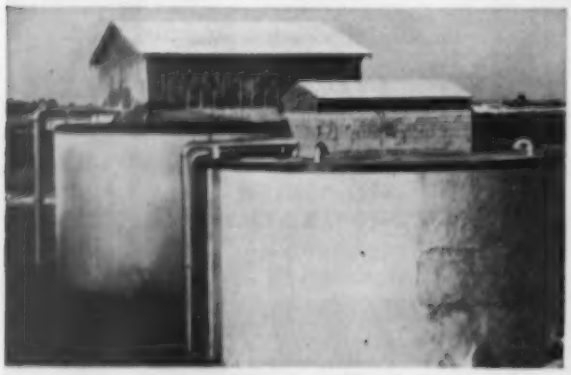
COMING ARTICLES

HOLLYWOOD (*Florida*) SAVES $32,980 A YEAR
regenerating its softeners with sea water

1. Pumps draw sea water from wells beneath this station. Being inland, these wells deliver a partially filtered sea water. (Regenerating costs are now $25 less per million gallons than when dry salt was used.)



4. City Engineer George A. Gieseke inspects the Permutit control panel. It backwashes, regenerates and rinses the 4 newest softeners and places them on the line . . . *all without aid from the plant operator!* Two men per shift operate the entire water plant.



2. To prevent marine growths which would foul equipment, the sea water is aerated and chlorinated.

5. Hollywood is growing fast. Their first four Permutit softeners went on the line twenty years ago. Now there are 12 . . . and plant space for more. "We're in good shape," says City Engineer Gieseke.

3. Sea water then passes through Permutit pressure filters (left) and is ready for regenerating the Permutit softeners (right). Sea water pumpage is kept to a minimum because high-capacity Permutit Q, used in the softeners, requires less salt for regeneration.

It's easy to see why Consulting Engineers *Reynolds, Smith & Hills* chose Permutit equipment . . . for its long service life and low operating costs. And we'll be glad to help you make sure your water supply is "in good shape" for the future. Write to: Dept. W-9, The Permutit Company, 330 West 42nd Street, New York 36, New York.

WATER CONDITIONING HEADQUARTERS

PERMUTIT

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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

COMING ARTICLES

Water Treatment at Norfolk, Virginia ..... *Hodges & Beasley*
Seymour, Wis., Solves Difficult Treatment Problem ..... *Clinton*
Features of Eugene, Ore., Sewage Treatment Plant ..... *Merrifield*
Control of Corrosion with Lime ..... *Hopkins*
Rational Approach to Design of Activated Sludge Plants ..... *Haseltine*
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Vol. 102 **SEPTEMBER 1955** **No. 10**

How to Avoid Sour Digesters 369
by David P. Backmeyer

FSIWA 28th Meeting Technical Program 378

The Measurement of Flowing Water 379
by Charles G. Richardson

1955 AWWA Chicago Conference Report—2 386

Centrifugal Pumps—Part 7 390
by Roy Carter and Igor J. Karassik

Chemical Handling and Feeding—Part 2 (23rd of a Series) 392
by G. E. Symons

A Critique on the Membrane Filter 400
by Maxim Lieber

Water Without Minerals 402
by I. B. Dick

Treatment of a Strong Carbohydrate and Chromium Waste 405
by George A. Rhame

Air Placed Concrete Repairs 90-year-old Leavenworth Sewer 410
by Ralph Cronemeyer

1955 ISP Conference Report 412
by John Finch

Editorial 414

Meetings Scheduled 108A

Spillway 116A

New Equipment 119A

Manufacturers' News 131A

New Literature 137A

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Joining or Repairing?

all pipe jobs are easier the

DRESSER WAY!

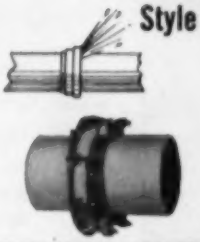
join or repair pipe with Style 38 DRESSER COUPLINGS

Proved by seventy-five years' service, these steel couplings provide flexible, bottle-tight connections that last the life of the line.

No costly threading, beveling, exact pipe fitting or alignment is required! The resilient Dresser Gaskets absorb vibration and pipe movement, permit curves to be laid with straight pipe lengths. Installation is safe and sure; there's no hazard to workmen or delays due to weather.

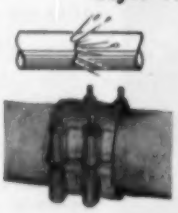
Easy to transport and handle, Style 38 Dresser Couplings are available from ⅝" ID to 72" OD and larger. Specify them for all contract installations; keep a selection for any emergency repair needs!

repair bell-and-spigot joints with Style 60 BELL JOINT CLAMPS



These highly adjustable clamps *stop* or *prevent* cast iron bell joint leaks permanently. Gaskets absorb vibration; clamps are especially good on locations such as under railroad tracks, highways, and on bridges. Sizes: 3" through 60" CIP.

repair asbestos-cement or CIP with Style 179 HYDREPAIR* CLAMPS



Featuring a "wrap-around" gasket seal, this lightweight, low-cost clamp fits virtually all diameters within a nominal pipe-size range . . . repairs either rough barrel or machined ends of asbestos-cement pipe, and all classes of cast iron.

DRESSER®

75th ANNIVERSARY — THE DRESSER WAY — 1880 • 1955

FITTING PARTNER FOR THE WATER INDUSTRY

Make safe, economical service connections with Style 91 DRESSER SERVICE SADDLES

RUGGEDLY CONSTRUCTED
Strong, high-quality, malleable iron bodies are heavily reinforced for maximum dependability.

FULL TAPPING RANGE
Available with AWWA Corporation Stop or Iron Pipe Size Thread taps. Large boss insures full threads.

FLAT STEEL STRAPS
Steel straps have rolled threads for greater safety, flat bearing surfaces to prevent cutting or crushing.

New Dresser Style 91 Saddles fit all sizes of steel, cast iron and asbestos-cement pipe, through 12", with size ranges clearly marked on the bodies of each.

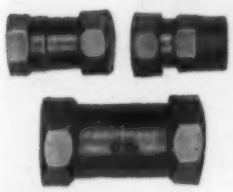
New plastic coating protects exposed threads and surfaces. Cold-rolled threads provide greater strap strength and resistance to corrosion. To assure permanent sealing, a strong, resilient rubber compound gasket is cemented securely in place.

Keep a stock of Style 91s on hand at all times. Designed by Dresser to fit the job, they assure the easiest, most practical way of making permanent service connections to water mains!

join or repair small pipe with Style 65 NO-THREAD FITTINGS

No exact pipe fitting or alignment, no threading required! Simply stab these factory-assembled compression fittings over plain pipe ends, tighten the nuts and you have a permanently sealed yet flexible joint. For all standard shapes, from ⅜" to 2".

renew or repair with bottle-tight Style 88 COPR-TUBE FITTINGS



These fittings are ideal for connections at the curb cock for renewals, for repairing torn-up services, sleeving in new lengths of copper tubing. Using the same principle as other Dresser Compression Fittings, Style 88s provide a lasting seal. Available in copper tubing, sizes to 2".

The Easy Way Is the DRESSER Way!

To assure quick, simple, economical installations or repairs—the kind that stay bottle-tight and trouble-free indefinitely—water men are specifying Dresser more and more!

Every Dresser Coupling, Compression Fitting and repair device is designed to answer a specific water piping problem. Each reaches its job ready for immediate installation. Work can be done in any weather with a wrench the only tool required. And with Dresser, even inexperienced workmen make permanent, leakproof joints or repairs every time. Installation time and money are saved because there's no need for complicated operations or cumbersome equipment.

Your local waterworks supplier can give you full details on all the Dresser units described here and the many other Dresser products he stocks. Call him for fast delivery today!

*Trade-mark of Dresser Manufacturing Division

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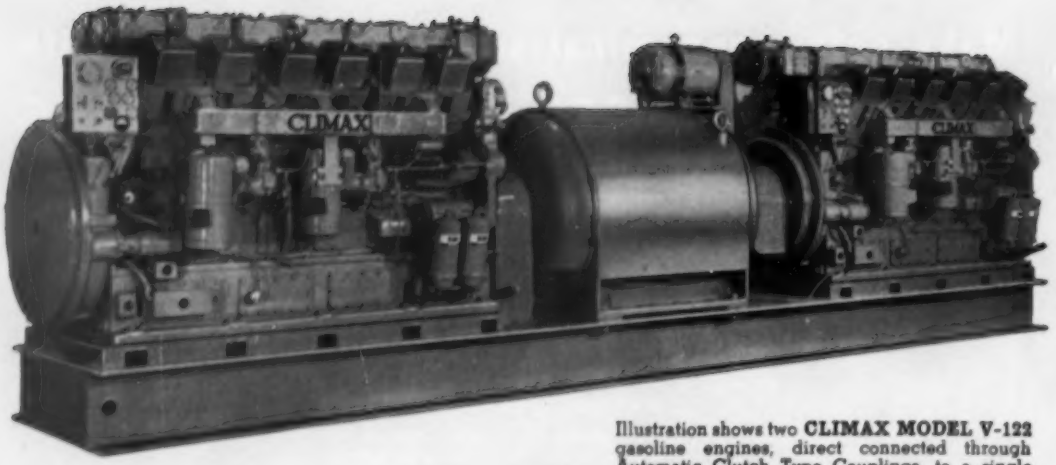


Illustration shows two **CLIMAX MODEL V-122** gasoline engines, direct connected through Automatic Clutch Type Couplings, to a single 625 KVA, 500KW, 1200 RPM, 3 phase, 60 cycle, 2400 volt AC Generator. This unit is installed in the **WASHINGTON TERRACE PUMPING STATION, ST. PETERSBURG, FLORIDA.**

STANDBY PROTECTION

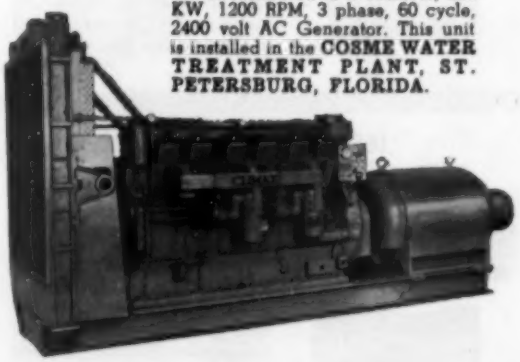
WHEN YOUR POWER FAILS

In connection with the modernization and expansion of its Water Works System, the **CITY OF ST. PETERSBURG, FLORIDA** recently installed two Climax engine driven generator sets for use on a standby basis. The **TWO UNITS ILLUSTRATED** are used when normal sources of power are interrupted by tropical storms or mechanical failures.

Each of these generator sets is designed for instantaneous starting, and both are capable of supplying necessary power to operate the motor driven pumps.

Design and construction engineered by Greeley and Hansen, Chicago, Illinois.

Illustration shows one **CLIMAX MODEL V-122** gasoline engine, direct connected to a 312KVA, 250 KW, 1200 RPM, 3 phase, 60 cycle, 2400 volt AC Generator. This unit is installed in the **COSME WATER TREATMENT PLANT, ST. PETERSBURG, FLORIDA.**



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CHICAGO 4, ILLINOIS
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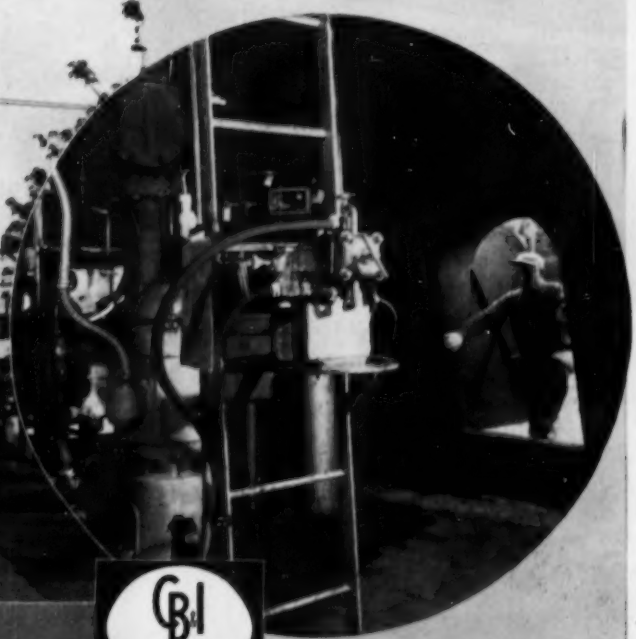
Sound Engineering and Modern Design

The pleasing symmetry of a Horton Watersphere® is fast becoming a symbol of progress, utility and good water service. Combining sound engineering principles with modern design they are providing private and municipal water systems with a dependable gravity pressure water supply for domestic, commercial or emergency use.

Waterspheres are built in capacities to 250,000 gallons. Write our nearest office for further information.



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Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
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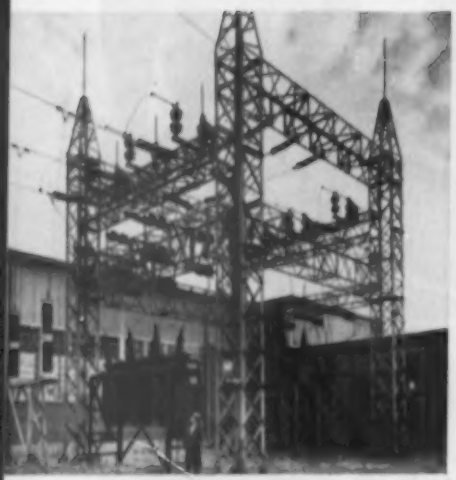
Plants in
BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

Above left: 50,000-gal. Horton Watersphere at Aroma Park, Ill.

Above: Interior view of Watersphere's base showing its use for housing water treating and pumping equipment.

Houston water purification plant, Houston, Texas. Architects and Engineers: Freese, Nichols & Turner. General Contractors: Brown & Root, Inc.—all of Houston, Texas.



Westinghouse coordinated substation is arranged for economical expansion. An extra bay and transformer can be added easily whenever other feeders may be required.

Westinghouse indoor metal-clad switchgear provides positive protection for the entire electrical system through its drawout air circuit breakers. Matched unit construction assures economical expansion.

This Westinghouse control center simplifies motor operation by grouping all controls for 57 motors. There are three such control centers. All units can be easily rearranged or expanded.

FACT:

They engineered an electrical system that anticipates future expansion

flexible design of Westinghouse apparatus permits installed horsepower to more than double

Problem: At the *City of Houston* water purification plant, the possibility of a 100% increase in installed horsepower over the next few years made flexibility a major requirement when the electrical system was engineered.

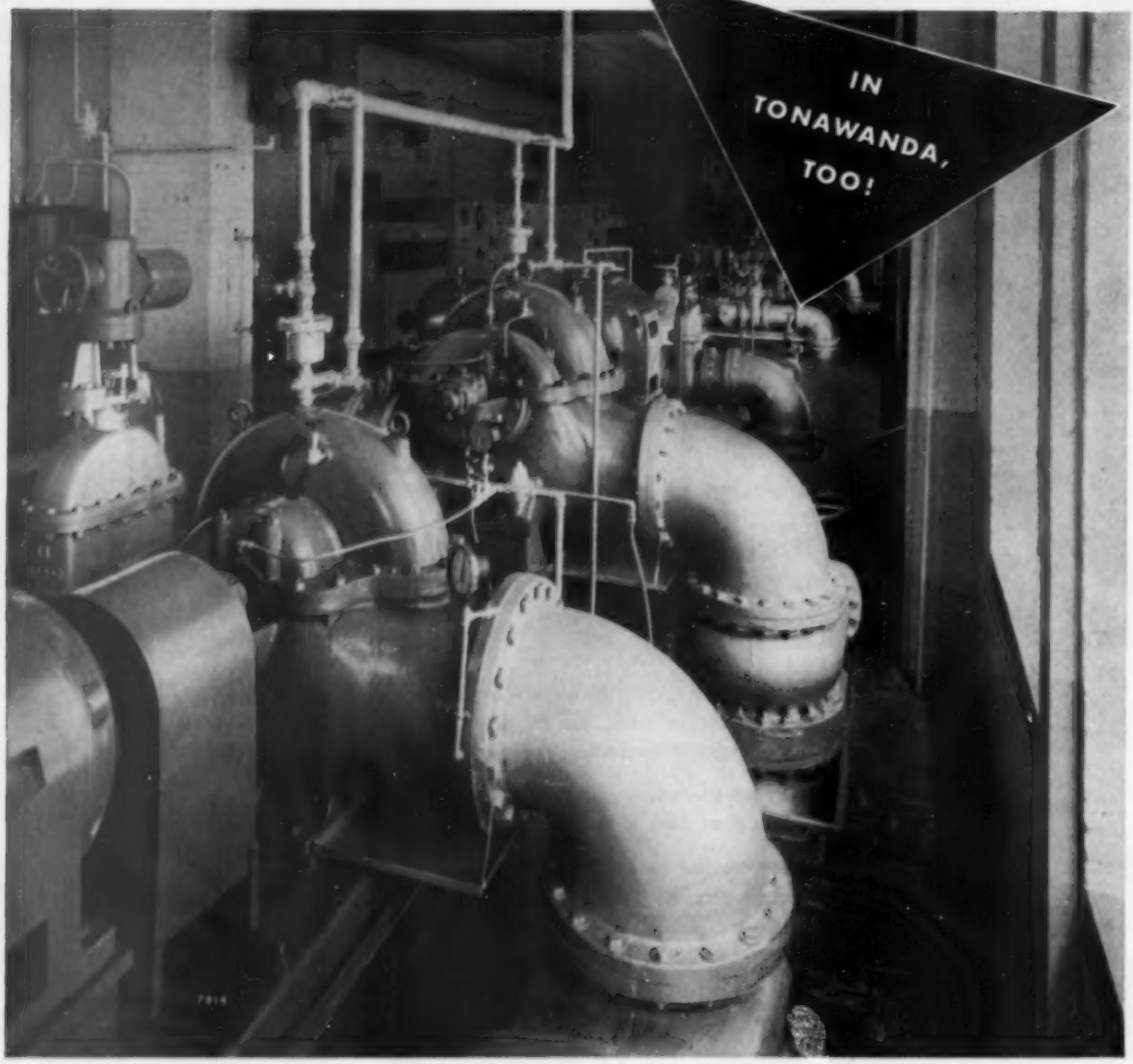
Solution: An electrical system containing Westinghouse apparatus that has the inherent flexibility to meet tomorrow's expansion plans.

Results: From the coordinated outdoor substation to the indoor switchgear and control centers, future electrical needs have been anticipated. Each Westinghouse component features modular construction. Each permits additions or changes . . . easily and economically . . . as power requirements dictate.

For the full story, call *The Man With The Facts* . . . the construction sales engineer at your nearby Westinghouse office. J-94047

YOU CAN BE SURE...IF IT'S Westinghouse

DE LAVAL pumps America's water...



Six De Laval pumps are on the job in the recently modernized Tonawanda, New York water works. These efficient pumps have a total capacity of 40 mgd, thus help meet the increased needs of this growing community.

Today 80% of all cities in the United States, with a population of 100,000 or over, use De Laval centrifugal pumps. Capacities of De Laval centrifugal water works pumps range from 100 thousand to 100 million gallons per day. *Write for your copy of new De Laval Bulletin 1004 giving data on these pumps.*

Consulting Engineers:
Metcalf & Eddy,
Boston, Massachusetts

Operating Superintendent:
Oscar B. Schulte

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
824 Nottingham Way, Trenton 2, New Jersey

Giant crops *of microscopic algae . . . rich in vital food elements . . . grown under the sea to help feed a hungry world. Scientists say it will come.*

100 years from now... WE'LL "FARM" THE SEA TO FEED A HUNGRY WORLD!

Hard to imagine. But in the fabulous world of tomorrow, there'll be one familiar note: water and gas will still be carried by the dependable, cast iron pipe laid today. Over sixty American cities still use cast iron water and gas mains a century and more old. And today, U.S. Pipe...centrifugally cast and quality-controlled from mines to blast furnaces to finished product...is even tougher, stronger, more durable.

U. S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE
CAST IRON

U. S. PIPE AND FOUNDRY CO., General Office: Birmingham, Alabama
A wholly integrated producer from mines and blast furnaces to finished pipe.

ONE OF THREE WORTHINGTON PUMPS in new addition to City of Dallas' Cadiz Street pumping station.

Worthington keeps Dallas pumping station a step ahead of city's growth

Fast-growing Dallas has to look ahead to future city expansion when planning improvements in its sewage disposal system.

City engineers kept that in mind when they built the addition to the Cadiz Street pumping station. They provided room for a total of six pumps to handle raw, screened sewage — and installed three Worthingtons. Eventually, they'll install pumps in the three remaining bays, but so far the three Worthingtons have been enough.

Just one example of Worthington service to municipalities everywhere. There's a Worthington unit for your municipal or industrial application — with design and construction proven on the job. Write Worthington Corporation, Public Works Division, Section W.5.2, Harrison, New Jersey.

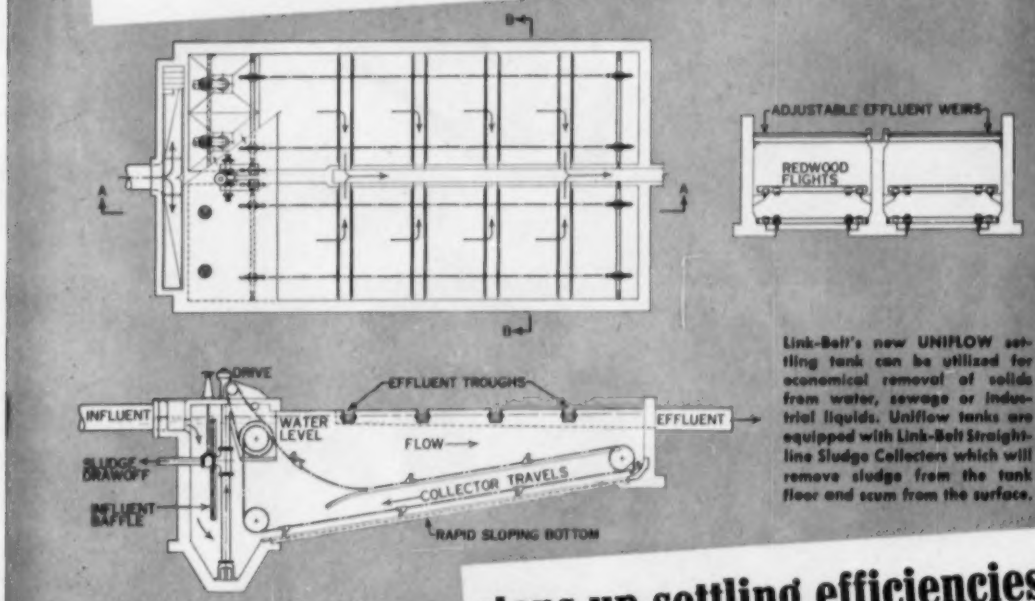
W.5.2

WORTHINGTON

ALL MAJOR PUBLIC WORKS EQUIPMENT UNDER ONE RESPONSIBILITY

Water Works Pumps • Sewage Pumps • Comminutors • Vertical Turbine Pumps • Vacuum Pumps

New UNIFLOW settling tank



Link-Belt's new UNIFLOW settling tank can be utilized for economical removal of solids from water, sewage or industrial liquids. Uniflow tanks are equipped with Link-Belt Straight-line Sludge Collectors which will remove sludge from the tank floor and scum from the surface.

steps up settling efficiencies . . cuts construction costs

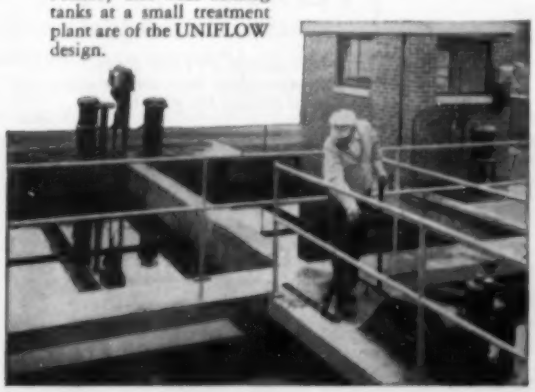
LINK-BELT development offers new economies for water, sewage and industrial liquids treatment

WITH its rapidly sloping bottom and multiple effluent weirs, Link-Belt's new UNIFLOW settling tank represents a big design advance. These, combined with the decreasing cross sectional area, provide *uniform velocity throughout the tank.*

Result: Better settling conditions . . . low overflow rate . . . uniform discharge from a large area of the tank surface. In fact, on one New England experimental installation, UNIFLOW gave practically the same efficiency in B.O.D. and suspended solids removal as a conventional tank with one-third more volume.

The new economies possible with UNIFLOW are typical of the development work constantly under way at Link-Belt. If you have a water, sewage or industrial waste problem, our engineers will work with your engineers, chemists and consultants. They'll help you get the finest in modern treatment equipment.

Primary and final settling tanks at a small treatment plant are of the UNIFLOW design.



LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.005

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

Visit Our Booths 14-15—Sewage Works and Industrial Wastes Convention—Atlantic City, N. J.—October 10-13

They choose TYLOX Flexible PIPE JOINTS

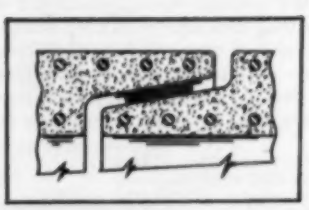
to assure

LEAK-PROOF, CORROSION-RESISTANT PIPE LINES

Thousands of Dublin citizens view this TYLOX-Jointed concrete pipe as it passes in review during a St. Patrick's Day Industrial Parade. Manufactured by Moracrete, Ltd., of Dublin, it is part of 53,000 feet of similar pipe required for the $6,000,000 North Dublin Drainage Scheme.

In designing the system, engineers knew that no ordinary pipe joint could last for long under the tough conditions involved. Its location along the coast meant the line would be subject to severe VIBRATION, SHEAR stress and CORROSION. In fact, there was only *one* pipe joint the engineers felt safe in specifying . . . TYLOX Rubber Joints.

TYLOX-Jointed pipe lines are giving trouble-free service under "tough" conditions, all over the world. That's why more and more waste disposal authorities are specifying "TYLOX" for their projects. Like the Dublin officials, they want to make sure their pipe joints are safe from failure, *whatever* the conditions.



Non-corrodable TYLOX Joints seal water-tight by compression, and outlast the pipe itself.

WRITE FOR our new 20-page booklet "Joint Enterprise." Read the facts on TYLOX — and the case histories supporting the facts — and specify TYLOX Rubber Joints on your next pipe job.

HAMILTON KENT
MANUFACTURING COMPANY
KENT, OHIO
427 West Grant St. Orchard 3-9555

New Oliver Jet Trencher for OC-3 Loader hooks up or detaches in 90 seconds

Exclusive 2-point hitch does the trick!

This new Jet Trencher is the perfect addition to the famous Oliver OC-3 Loader. It digs to 12 feet and lifts to 11½ feet—adds extra versatility without limiting tractor maneuverability or loader operation.

The exclusive hydraulic 2-point hitch makes hookup and removal a simple, one-man operation from the tractor seat. When the trencher is removed, the hitch holds the loader counterweight or quickly takes a number of handy attachments—scrapers, scarifiers, etc.

All new in design and construction, the Jet Trencher places all stress and strain on the trencher frame, not on the tractor, Its new mounting, offset to the side of the tractor, gives unmatched visibility and permits close parallel digging to walls, foundations. Full 180° boom swing gives straight side dumping.

Working from the loader hydraulic system, the Jet Trencher has powerful down pressure for digging through tough soil. Hydraulic control gives smooth, cushioned operations and insures long-life, low-upkeep operation. See this new trencher and OC-3 Loader. Ask your Oliver Industrial Distributor for a demonstration.

Hydraulic 2-point hitch is adjusted to fit slots on sides of trencher as tractor is backed into position. Snap-on fittings connect hydraulic lines—seat is swung around and trencher is ready to operate. When not attached, trencher rests, as shown here, on stabilizer blade and bucket.

THE OLIVER CORPORATION
400 West Madison Street, Chicago 6, Illinois

OLIVER

a complete line of industrial wheel and crawler tractors

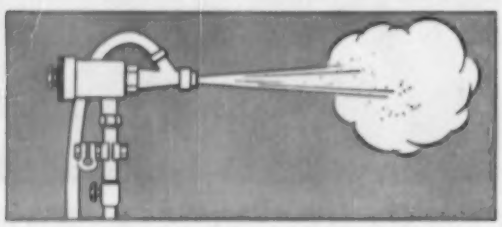
What can you do about sewage odor complaints?

Even the most modern sewage plant often gets complaints from the public. When care, cleanliness and chlorination fail, and you still get sewage odor complaints, what can be done?

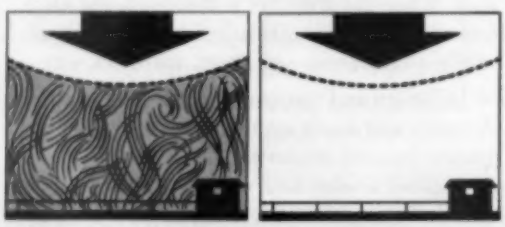
A group of Airkem odor counteractants is solving this problem for sewage plants throughout the country. Application is simple: the odor counteractant is dispersed into the air through air-spray nozzles. Molecular dispersion combines the counteractant with the atmospheric airstream to reduce odors immediately.

Air inversion is often the cause of odor complaints. When atmospheric conditions block off normal odor-escape routes, odors cling to the ground and often develop into a public relations problem. Airkem solves this problem because it covers every dispersion area.

A consultation with Airkem will be completely confidential and there is absolutely no obligation. Call your Airkem representative listed in the phone book or write Airkem, Inc., 241 East 44 Street, New York 17, N. Y.



Airkem air-spray nozzle disperses effective odor counteractant into atmospheric airstream.



Airkem covers entire dispersion area under air inversion conditions. Counteracts odor immediately.

For Industrial • Municipal • Institutional • Commercial Use

AIRKEM ODOR COUNTERACTANTS

airkem

Water is vital...

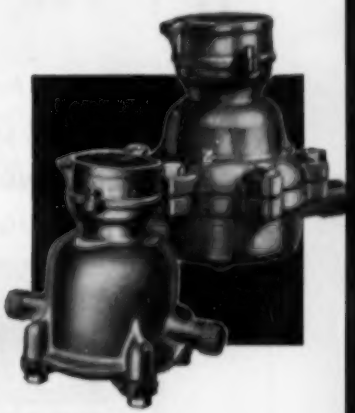
Badger meters conserve it better!

THEY say oil and water do not mix — yet the oil industry uses more than 1600 billion gallons of water annually for refining petroleum. And *nearly 40% of the water used is furnished by public water systems.*

To pinpoint this tremendous volume—more than 4 gallons of water are used in the production of one quart of oil for your automobile.

The Badger water meters used throughout the nation help conserve water for this need . . . just as they do for hundreds of other essential industries and for vital home usage. They measure water accurately . . . provide a precise check on water consumption and waste . . . serving communities by helping make water departments more efficient and self-supporting.

As the experience of waterworks men everywhere shows, Badger meters do the job dependably . . . are a sound investment that pays dividends year after year.



Badger Water Meters

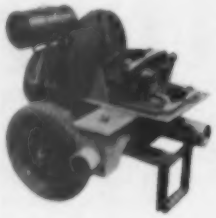
Badger Meter Mfg. Co.
Milwaukee 45, Wisconsin

"Measuring the water of the world for 50 years"

for . . .

Quality
Dependability
Economy
Delivery
Service

DIAPHRAGM PUMPS



MELTING FURNACES

JOINT RUNNERS

CALKING TOOLS

MANHOLE CUSHION

PIPE CUTTERS

SEWER CONNECTIONS

M-SCOPE PIPE FINDER

it's **POLLARD**

for pipe line equipment

and for Convenience . . .

THE NEW POLLARD CATALOG LISTS HUNDREDS OF MODERN PRODUCTS DESIGNED TO MEET YOUR EVERY REQUIREMENT.

Pollard
Catalog 26

PIPE LINE EQUIPMENT
JOSEPH G. POLLARD CO., INC.
PIPE LINE EQUIPMENT
PIPE LINE EQUIPMENT

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If it's from POLLARD . . . it's the Best in Pipe Line Equipment

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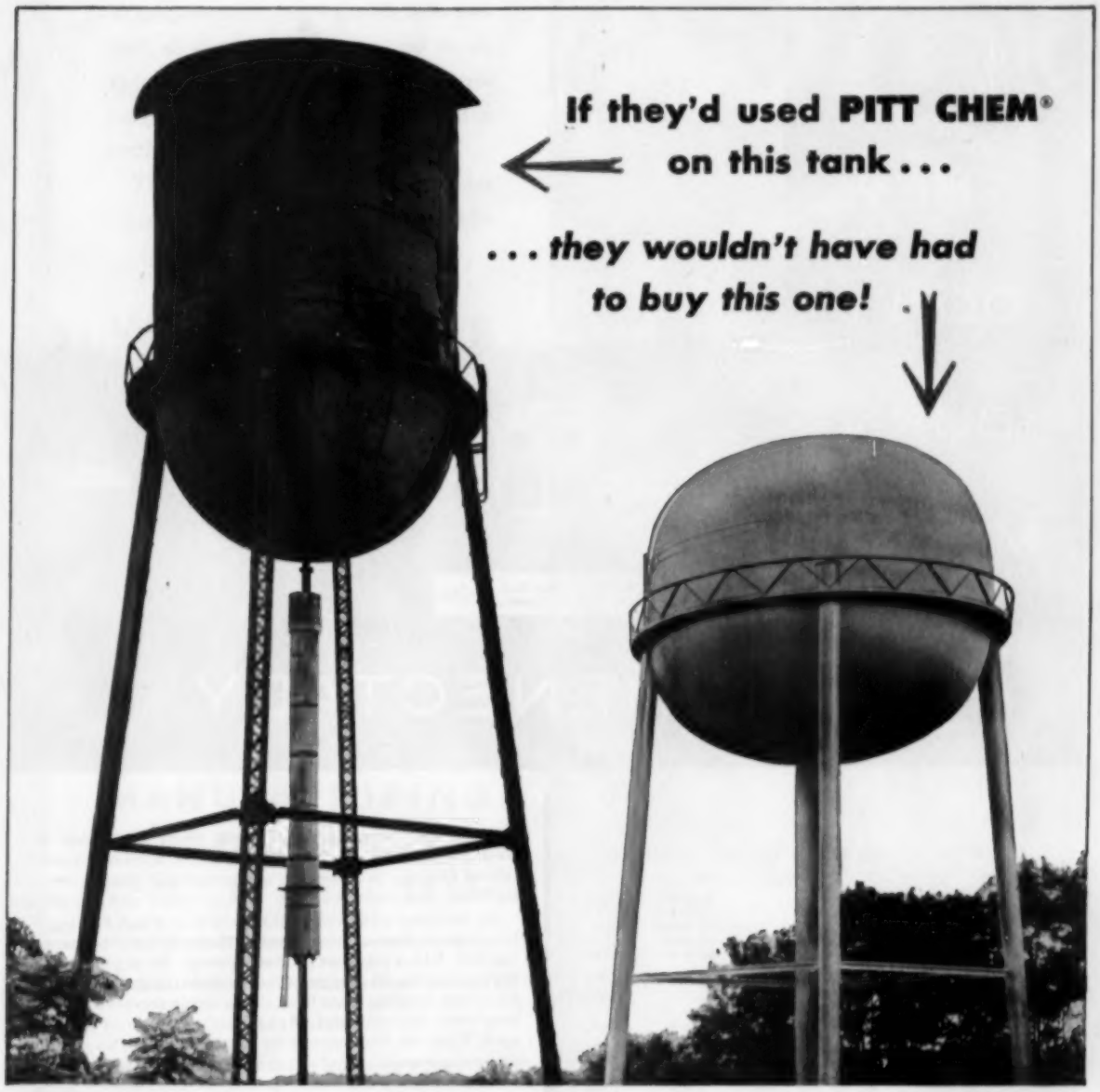
333 Candler Building, Atlanta, Georgia



THEY TRIED to protect the water tank on the left with ordinary paint. That's why they had to recently erect its replacement on the right!

But *this* time they beat corrosion to the punch. A *Pitt Chem* engineer was called in prior to actual construction. Here's what he recommended: (1) Protect the tank interior with *Pitt Chem* 104—a tough, durable, water resistant coating that imparts no taste or odor to water. (2) Protect exterior tank surfaces with *Pitt Chem* 209 Alkyd Resin Aluminum Coating to combine attractive appearance with maximum resistance to atmospheric corrosion. (3) Protect the water pipe mains above ground and below with *Pitt Chem* 101, a thick, heavy duty tar base coating.

Thanks to *Pitt Chem*, the community is now assured of years of trouble-free service and maximum protection of their investment at minimum cost. Let us help you with *your* corrosion problems. ● Call or write today for technical information or engineering assistance.

W&D 5525

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

THEY DON'T BURN MONEY IN SCHENECTADY

Designed by Havens & Emerson, New York, N. Y.
Constructed by McElwee-Courbis, Camden, N. J.

C-E RAYMOND FLASH DRYING SYSTEMS PRODUCING FERTILIZER

CITY	TREATMENT	NO. UNITS	SIZE OF UNITS Lb. Water per Hour per Unit	INSTALLED CAPACITY Tons Fertilizer Per Year
Baltimore, Maryland	Act. Dig.	3	6,140	29,800
Battle Creek, Michigan	Pri. Dig.	1	2,370	2,550
Chicago, Illinois				
Calumet	Activated	3	9,667	15,850
Southwest	Activated	8	21,000	148,500
Southwest Ext.	Activated	6	21,000	49,500
Edgewater, New Jersey	Pri. Dig.	1	795	150
Fond Du Lac, Wisconsin	Pri. Dig.	1	2,350	1,300
Houston, Texas	Activated	2	12,000	30,400
Lansing, Michigan	Act. Dig. & Garbage	1	6,667	6,780
Los Angeles, California	Act. Dig.	4	22,500	79,500
Recife, Brazil	Pri. Dig.	1	943	1,280
San Diego, California				
#1 Plant	Pri. Dig.	1	3,500	7,500
#2 Plant	Pri. Dig.	1	5,000	13,200
San Francisco, California	Pri. Dig.	3	6,250	36,400
Schenectady, N. Y.	Pri. Dig.	1	3,370	2,970
Sheboygan, Wisconsin	Pri. Dig.	1	3,040	3,060
Stamford, Connecticut	Pri. Dig.	1	3,330	1,780
Washington, D. C.	Pri. Dig. now Act. Dig. later	3	12,000	65,500
Wyomissing, Pennsylvania	Pri. Dig.	1	2,218	848

Instead, the new sewage disposal plant at Schenectady, New York, *saves* money – sizable sums accruing from the sale of Orgro – Schenectady's effective soil conditioner and fertilizer composed entirely of flash-dried sewage sludge.

As in many other communities, a C-E Flash Drying System has converted what would otherwise be a bothersome liability into a revenue-producing asset. By drying, packaging and selling its sludge, and then deducting all fuel, power, labor and bagging costs from the revenue received, Schenectady nets approximately $15.00 for each ton of dry solids sold. Thus far the demand for Orgro has been so great that an average week's production is sold at the plant in a matter of hours. During the winter months, when consumer demand may drop off, Orgro will be bagged, stored and kept ready for use the following spring, on the city's parks and golf courses.

Had Schenectady elected to incinerate its sludge, not alone would all revenue be eliminated, but in addition, a cost of about $3.00 per ton would be incurred for ash disposal – a substantial item, since roughly 50% of the original dry weight of incinerated sludge remains as ash.

In communities where the character of the sludge makes it unsuitable for use as fertilizer, incineration may be the only answer. But in the many instances where these limitations do not apply, burning sludge may be equivalent to burning money.

Whether you plan to incinerate or dry, the C-E Raymond Flash Drying System allows you to do either at will. Like the communities listed at the left, you too can end your sludge disposal problems effectively and at less cost with the service-proved C-E Raymond System. For full information, contact the C-E Raymond office nearest you. A C-E specialist will be glad to help you. 8-792

COMBUSTION ENGINEERING
RAYMOND DIVISION
1315 North Branch Street, Chicago 22, Illinois

Eastern Office: 200 Madison Avenue, New York 16, New York • Western Office: 510 West Sixth Street, Los Angeles 14, California
ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

When water works officials select a water meter, they look for uniform performance, accurate registration and low maintenance cost.

These three features and many more are always found in

HERSEY WATER METERS

Another advantage that comes in dealing with Hersey is the service and advice based on over 69 years in the water meter business. To make this service readily available, well equipped Branches are located in the larger key cities where experienced water meter men are ready to serve you.

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

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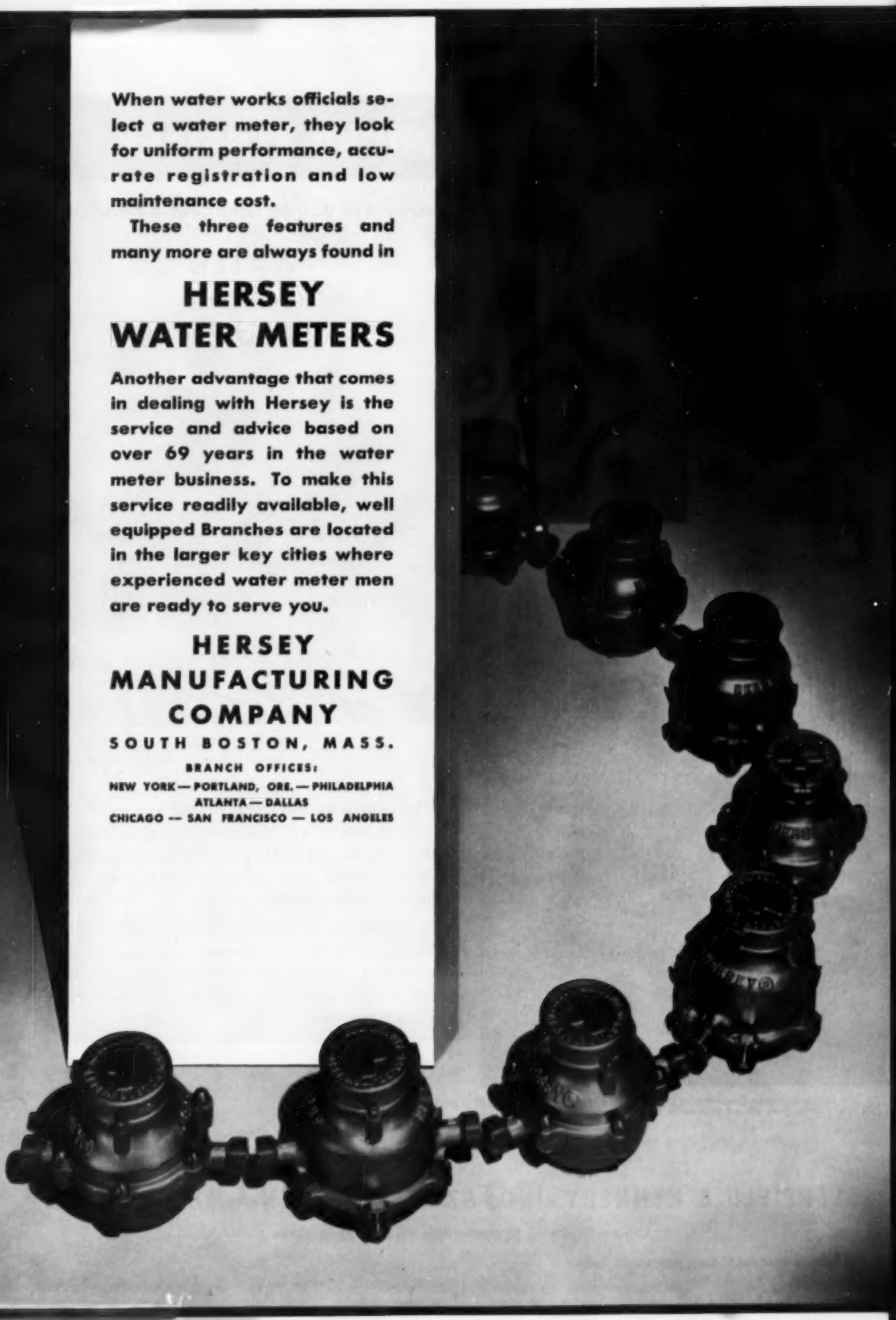


THE Glenfield MICRO-STRAINER*

A unique solution to treatment problems brought to you by Glenfield & Kennedy

A product of years of research and stringent field tests by a firm with a century of hydraulic engineering experience.

Used by more than 60 authorities in Britain and all over the world, including the cities of London, Derby, Liverpool, Bristol and Rio de Janeiro, the Glenfield Micro-strainer* is automatically and continuously operated under open gravity conditions with small head losses.

Compact layouts, small driving units and corrosion-resisting materials throughout ensure low initial operating and maintenance costs making the Glenfield unit the most dramatic contribution to water treatment practice in recent years.

The filtering medium of stainless steel threads so closely woven as to provide apertures down to approximately 23 microns across, retains all but the finest suspended matter while remaining tough and durable.

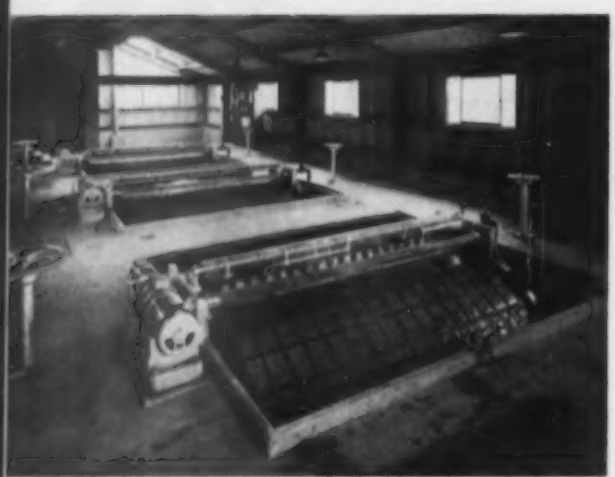
WATER

City of Bristol.—Third installation of three 7'6" x 5'0" dia. units under construction. Seven in all dealing with 21 m.g.d. (U.S.) prior to slow sand filtration. Works capacity increased thereby avoiding extension.

Micro-Straining has also been used as a sole filtration process to a public water supply at Preston, Eng. (17 m.g.d.) and to raise filtration rates where algal invasions reduce running times. It is also used for industrial purposes.

We are always interested in new straining problems and we shall be pleased to investigate any possible application of our product. In this connection a small pilot plant can be provided on site for testing purposes.

SEWAGE



City of Derby.—Three 10'0" x 10'0" dia. units filtering 12 m.g.d. (U.S.) humus Tank effluent at Spondon Sewage Works.

*Reg U. S. Patent Office. No. 2462604

GLENFIELD & KENNEDY, INC., 677 Fifth Ave., New York 22, N.Y.

Micro-Straining Equipment in all its Applications

Because We Have Freezing Weather
The Safest Meter to Buy is

AMERICAN

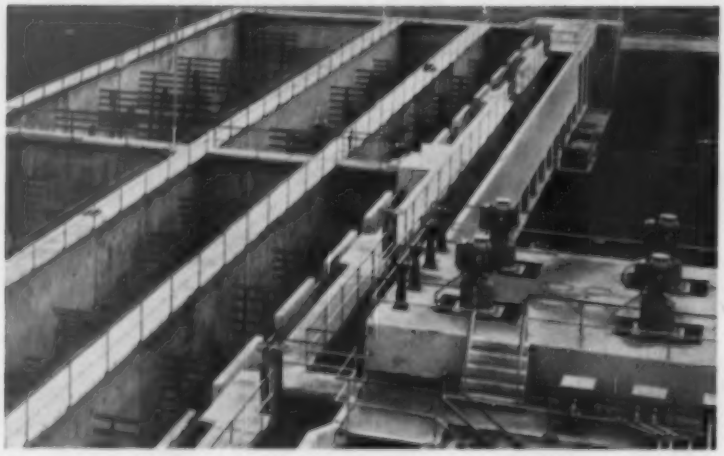
"American Frost Bottom Meters have complete frost protection — frost-separable gear train and chamber, with pre-tested breakable bottom. That reduces parts replacement costs, to the absolute minimum. I repair 'em. I know American is the safest meter to buy."

• In American Meters you know in advance what will happen in freezing. The frost bottom breaks, relieving pressure, so that internal working parts are not damaged. The bottom can be replaced in a few minutes. No complicated repair jobs. No expensive working parts to replace. No extra load on the repair department. That's why Repairmen say, "American is the safest to buy!"

BUFFALO METER CO.

2909 MAIN STREET • BUFFALO 14, N.Y.

Hundreds of cities rely on JEFFREY for dependable water treatment equipment



Jeffrey sanitary engineering and equipment can be applied effectively to any American city with "growing pains and a thirst."

Jeffrey's broad experience in the design and construction of sanitation systems covers all types of installations. You can turn your sanitation problem over to Jeffrey with complete confidence.

Hundreds of water, sewage and industrial waste plants throughout the nation are now Jeffrey-equipped. The complete Jeffrey line for Water Treatment Plants includes:

Bar and Disc Type Screens	FLOCTROLS
Screenings Grinders	Dry Feed Chemical Machines
Grit Collectors & Washers	Biofiltration Plant Equipment
Sludge Collectors	Garbage Grinders
Sludge Elevators	Belt and Spiral Conveyors
Scum Removers	Bucket Elevators
Power Transmission Machinery	Chains and Sprockets

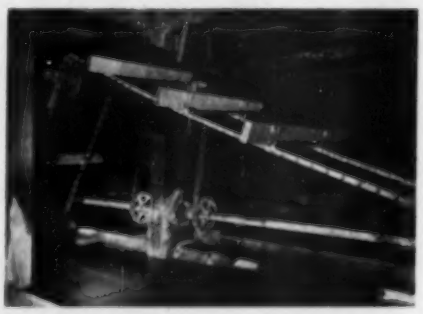
Traveling Water Screens

Below: A complete chemical handling system utilizing Jeffrey Power Scoop, Spiral Conveyors and Bucket Elevators. Material flows uninterrupted from cars to storage bins or chemical feeders.

At left: 14 Jeffrey FLOCTROLS, each 54' long, driven by 1½ hp. motor, have peripheral paddle speed of 1.2 to 1.8 ft. per second . . . 45-minute detention at 80 mgd. Note four Jeffrey Rapid Mixers at right.

Below: Jeffrey Spiral Conveyors carry chemicals from storage bins by bucket elevators to chemical feeders.

Below: Close-up of Jeffrey Sludge Collectors in action in the settling basins at large water treatment plant.



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THE JEFFREY MANUFACTURING CO.
ESTABLISHED 1877
Columbus 16, Ohio
sales offices and distributors in principal cities
PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED . . . IT'S A JOB FOR JEFFREY!

Dependable water storage—

AN ESSENTIAL PART OF ATLANTIC CITY'S WELCOME TO THE WORLD

PITTSBURGH
•DES MOINES

Elevated Steel Tanks

As host to millions, Atlantic City spares no effort to protect the health and safety of its guests. The resort's latest addition to better water service is this 1,000,000-gallon Pittsburgh-Des Moines Elevated Steel Tank. Of radial-cone design, the tank measures 71 feet in diameter, has a 35-foot head range, and tower height 80 feet to bottom. • Write for our "Modern Water Storage" brochure.

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

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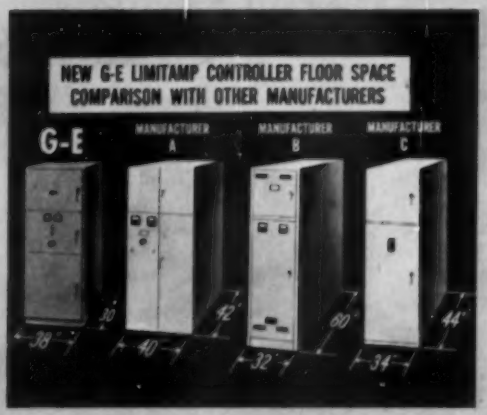


356 SQ. IN. LESS area than next smallest starter.

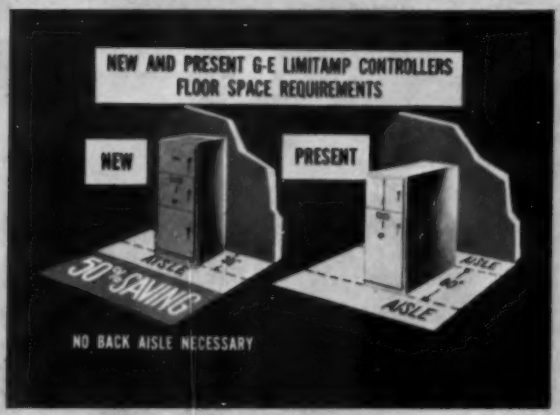
General Electric Announces . . .

NEW Limitamp*

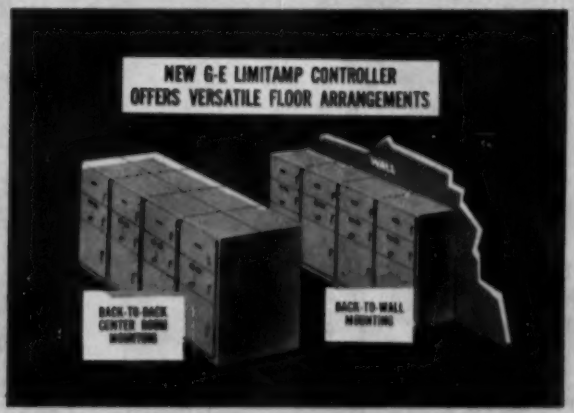
- **Gang-operated disconnect switch on all units**
- **Entirely front connected**
- **30-inch depth**
- **Low-voltage panel hinged to swing out of enclosure**
- **Contactor rolls in or out of cabinet**

NEW DESIGN

INSTALLATION IS SIMPLIFIED. A man can easily enter enclosure to make connections.



OVER 50% SPACE SAVINGS by elimination of back-aisle.



VERSATILE INSTALLATION—units all front connected.

Control saves over 50% floor space

ENTIRELY FRONT CONNECTED, only 30 inches deep, General Electric's all-new Limitamp control offers versatility of installation. New 30-inch depth allows unit to be transported through normal size doorways, and 90-inch height includes bus compartment. Back-to-back, back-to-wall, or mounting as free standing enclosure is now possible.

IDEAL FOR HIGH-VOLTAGE MOTORS, rated 2300-4800 volts and up to 3000 h-p, the new Limitamp control may be applied to squirrel-cage, synchronous, wound-rotor, and multi-speed motors on power systems requiring high interrupting capacity for maximum short-circuit protection.

NEW CONCEPTS IN SAFETY are built into new Limitamp control. Gang-operated disconnect switch, steel barriers between all compartments, enclosed bus compartment and co-ordination of starter assure you of safer high-voltage motor control.

G.E. LIMITAMP STARTERS are co-ordinated to provide maximum protection for equipment and personnel. Co-ordinated circuit components guard against needless fuse blowing, give running overload protection and provide maximum safe-guard against short-circuit damage for starter and equipment.

FOR COMPLETE APPLICATION ENGINEERING service contact your nearest G-E Apparatus Sales office. Write for Bulletin GEA-6331, Section 781-12, General Electric Co., Schenectady 5, New York.

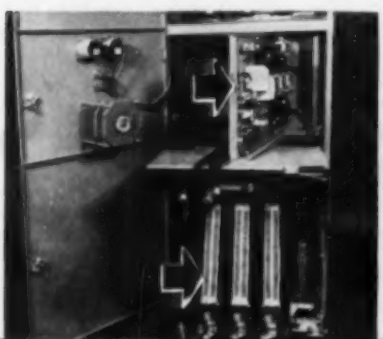
°Trade-mark of General Electric Company

Progress Is Our Most Important Product

GENERAL ELECTRIC

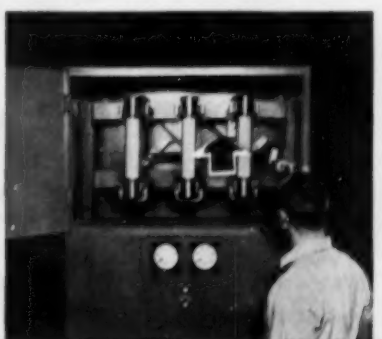
SIMPLIFIES INSTALLATION AND MAINTENANCE

MAINTENANCE IS EASY. Low-voltage panel swings out, contactor rolls out.



TYPE EJ-2 CURRENT-LIMITING fuses are safely, quickly replaced within seconds.

SAFE VISUAL CHECK of disconnect switch with fuse compartment door open.



Model GLW-0 Loss-in-Weight Gravimetric Feeder for maximum rate of 100 lbs. per hour.

Model GLW-1 Loss-in-Weight Gravimetric Feeder for maximum rate of 1,000 lbs. per hour.

Model GLW-2 Loss-in-Weight Gravimetric Feeder for maximum rate of 4,000 lbs. per hour.

When only the BEST is good enough . . .

don't shop for bargains

What does the super-accuracy of Omega Loss-In-Weight Gravimetric Feeders really mean to the modern water works? To some plants, these feeders mean *economy* . . . the last word in the control and conservation of costly water treating chemicals. Others pick Omega Loss-In-Weight Feeders for *safety*, knowing that these flood-proof feeders provide positive control of critical chemicals. Still others select Omega Loss-In-Weight Feeders for *flexibility*, to meet a wide range of raw water conditions and seasonal water demands.

If you are considering up-grading your chemical feeding equipment, or installing additional feeding capacity, investigate these and other advantages of Omega Loss-In-Weight Gravimetric Feeders . . . then you'll agree that only the best is good enough. Bulletins 30-H12A and 30-K4 give complete details — send for your copies today. Omega Machine Co., 350 Harris Av., Prov. 1, R. I.

OMEGA *THE LAST WORD IN* **FEEDERS**

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • BUILDERS-PROVIDENCE, INC.

BIF METERS FEEDERS CONTROLS

Oftentimes, the difference between good and bad tasting water is the correct dosage of AQUA NUCHAR activated carbon, applied at the right place. Using only enough AQUA NUCHAR activated carbon simply to reduce the threshold odor from 50 to 25 is not sufficient. Plant operators must constantly strive to deliver a palatable water – which means a Threshold Odor of 5 or less.

Thus, they will accomplish a distinct improvement which can be detected by even the layman. Consumers will also be appreciative, even though they may not say so, verbally.

To keep a constant check on the most efficient dosages required, as well as the most effective point of application, consult with our Threshold Odor Specialists. They will make a complete taste and odor survey of your water treatment plant, and explain to your chemist the procedures of the Threshold Odor Test. Another feature of their regular service will be to check, without obligation, the influences of other chemicals used and recommend how AQUA NUCHAR activated carbon may best be employed.

NUCHAR

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Cleveland 20, Ohio

TOWN FIGHTS "RED" MENACE!

Visitors to the recent AWWA convention saw how the town of "Clear Water" rid itself of the Red Water Problem with Calgon* Threshold Treatment

This graphic display, showing how Calgon works, demonstrated a method of water control familiar to water works superintendents from coast to coast. They know from experience that Calgon not only stabilizes dissolved iron and manganese (preventing red or black water) but also controls corrosion† and tuberculation by forming a protective film on metal surfaces.

Calgon is effective against lime scale formation, too, and stabilizes lime soda softened water to control calcium carbonate precipitation.

Many years of experience with water conditions all over the country are at your service. Write or phone for information about your particular problem.

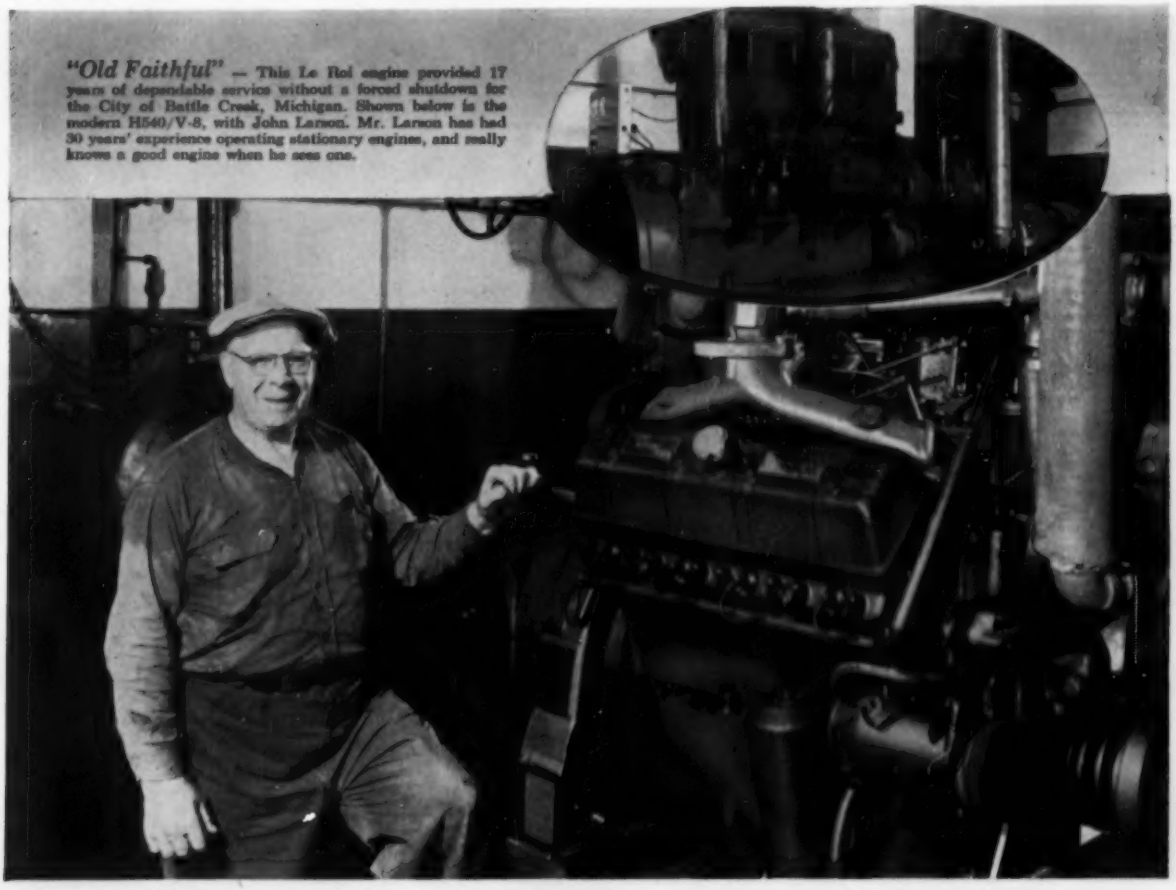
*Calgon is the Registered Trade Mark of Calgon, Inc. for its glassy phosphate (sodium hexametaphosphate) products.

†Fully licensed for use under U.S. patent 2,337,856 and 2,304,850.

CALGON, INC.

A SUBSIDIARY OF HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PA.



"Old Faithful" — This Le Roi engine provided 17 years of dependable service without a forced shutdown for the City of Battle Creek, Michigan. Shown below is the modern H540/V-8, with John Larson. Mr. Larson has had 30 years' experience operating stationary engines, and really knows a good engine when he sees one.

122,105.6 hours logged with only four overhauls

...dependable performance like this proves the value of Le Roi engines

In 1937, the City of Battle Creek installed its first Le Roi engine. Seventeen years later, when it was time to modernize, this engine had piled up the amazing total of hours shown above.

This is just one more example of Le Roi dependability. It is also proof of the excellent maintenance work performed by John Larson and his staff.

In 1954, "Old Faithful" was replaced by Le Roi's H540, a modern short-stroke V-8. The H540 normally operates at 1500 rpm, but, because of its short stroke V-8 design, piston speed is no greater than that of longer stroke, slower speed engines.

Moreover, the H540 provides new flexibility. This flexibility really paid off during flood conditions when the electric pumps were shorted out. The H540 ran up to 2100 rpm and, by so doing, carried the entire plant load for several days.

Performance during this emergency clearly indicated the advantages of the H540's short-stroke V-8 design. It proved that you get more horsepower per dollar and more horsepower per space. Other plus factors are easier servicing and easier installation.

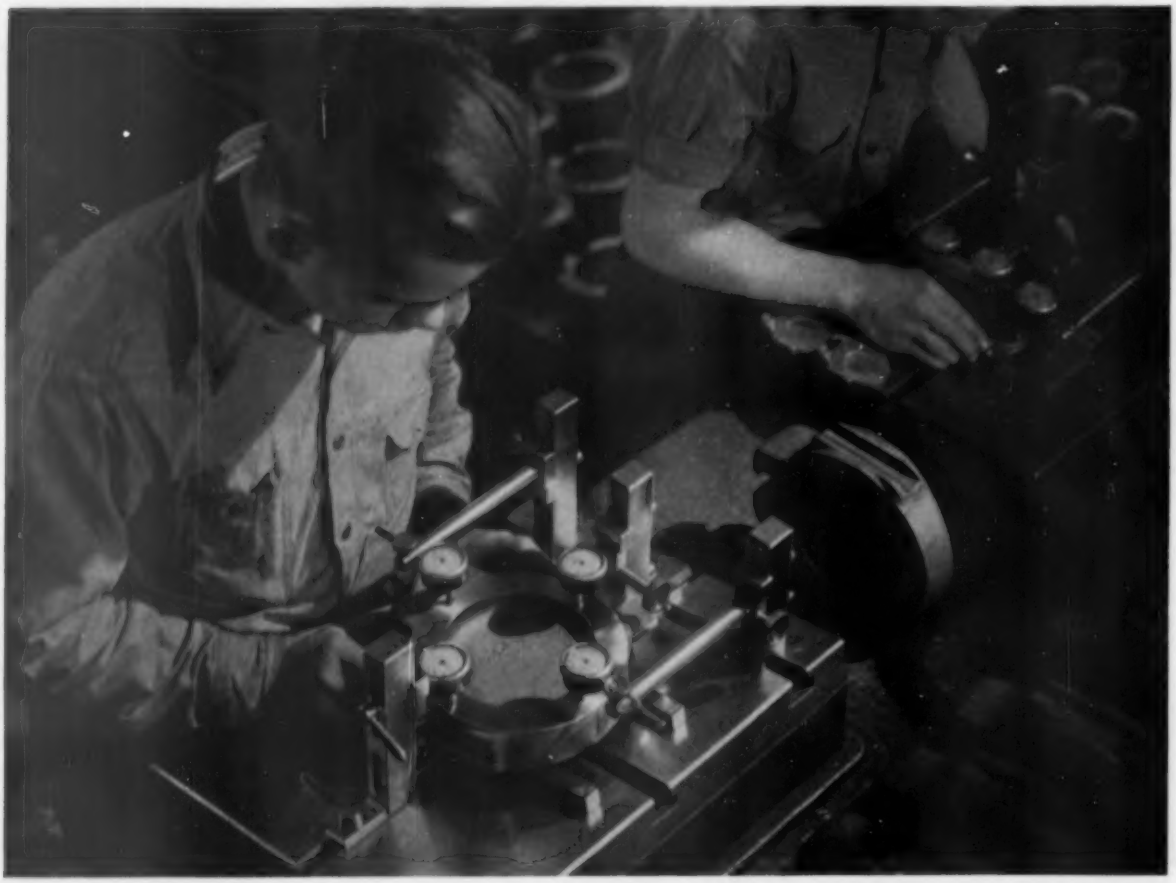
Whether it's for continuous or standby service, or for pumps, blowers, or generators, it pays to use Le Roi engines. Le Roi power is dependable, low-cost power — power that can help ease the tax load in your community. You can get it in sizes ranging to 645 hp., or in custom generator sets from 50 to 350 KW. Write us for detailed information.

E-103

LE ROI *Division of Westinghouse Air Brake Co.*

Milwaukee 14, Wisconsin

PORTABLE AIR COMPRESSORS · TRACTAIR · STATIONARY AIR COMPRESSORS · AIR TOOLS · ENGINES



61,167 gauges...to deliver your Crane Valves 100% quality inspected

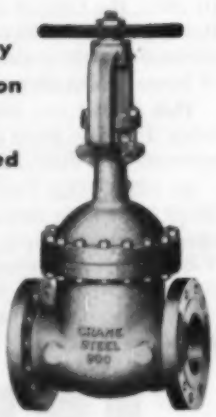
Care-how! A newly coined catch-phrase? Not at Crane! It is a rigidly-adhered-to principle of quality control—100 years old!

By way of example, the Crane technician in the photograph is checking the taper, size and guide slot alignment on gate valve discs. Every disc must correspond to the setting of the indicators—to tolerances of .001 inch plus or minus, on the taper, and .008 inch on the alignment of the slot guides. And Crane uses 61,167 gauges to insure dimensional accuracy.

Why this Care-how? To assure you of smoother, longer lasting valve operation, with lower maintenance and repair costs.

There you have the reasons why knowing and thrifty buyers prefer Crane valves . . . why industry uses more Crane valves than any other make! And the reasons why you should always buy Crane. Crane Co., General Offices, 836 S. Michigan Ave., Chicago 5, Illinois. Branches and Wholesalers serving all industrial areas.

Better Quality
Bigger Selection
in Valves
for Every Need

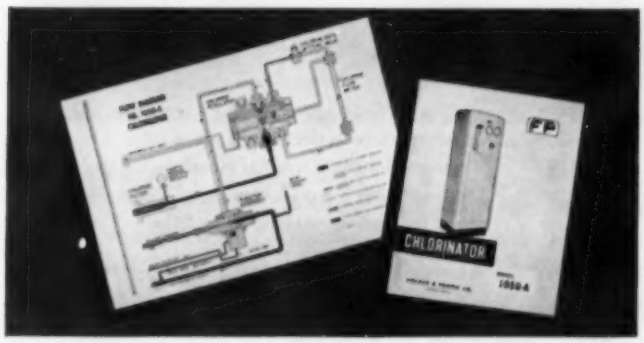


CRANE CO.

VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY...1855-1955

Willard Harper, Chief Chemist, adjusts the setting on a Ratochlor unit.



Flow diagram shows the simplicity of the Fischer & Porter Model 1050-A Chlorinator. This 6-page folder gives additional information. Send for your free copy today.

FP *complete process instrumentation*

F&P Chlorinator Proven Under Severe Test by City of Columbus

Freedom from corrosion, low maintenance and operating costs induce city officials to acclaim its virtues

Faced with the need of replacing its 40-year-old chlorinator, the City of Columbus, Ohio, tested an F&P chlorinator for 8 months under the most adverse conditions. So pleased were Marshall Houghn, chief of the Dublin Road plant, Willard Harper, Chief Chemist, Paul C. Laux, Water Division superintendent, and Floyd C. Redick, Public Service Director, with its performance that two new Fischer & Porter Chlorinators and an Evaporator were installed. The Dublin plant keeps one chlorinator in constant operation and the other for reserve purposes.

Here are the features of the F&P Model 1050-A Chlorinator—

- Only materials completely inert to corrosion are used in construction
- Cabinet made of plastic-impregnated Fiberglas —never needs painting
- Simplicity of operation—internal piping in vacuum system employs "snap-in" type construction with "O" rings requiring no unions
- Designed for installation by unskilled labor

Fischer & Porter offers a wide variety of chlorinators for use in municipal water systems, industrial plants, swimming pools. Consult your local F&P representative or write for free literature.

FISCHER & PORTER COMPANY

15 COUNTY LINE ROAD • HATBORO 15, PA.

Measuring, recording and controlling instruments
Centralized control systems
Data reduction and automation systems
Chlorination equipment
Industrial glass products

Sales offices in 32 American cities and in principal cities abroad

what have

The Galapagos Turtle (or Tortoise) is an inhabitant of the tropics.
It often has a life span of 150 years and weighs up to 500 pounds. Once numerous, its ranks became decimated when man discovered it could live for months without food—making it a good source of fresh meat for sailing vessels, especially whaling ships.

This cast iron water main laid in 1835 by the Bureau of Water of Lancaster is still functioning after 119 years of service.

MODERNIZED cast iron

they in common...

THE TURTLE AND CAST IRON PIPE...LONG LIFE!

The Galapagos Tuftle frequently lives to be over 100 . . . an outstanding example of longevity in the animal kingdom. In our everyday world, CAST IRON PIPE lives . . . and serves . . . for centuries.

AND HERE'S THE PROOF: Listed below are some of the many water utilities still using cast iron pipe that was installed a century or more ago.

DEPARTMENT OF WATER AND WATER SUPPLY, City of Albany, New York
ALEXANDRIA WATER COMPANY, Alexandria, Virginia
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Baltimore, Maryland
PUBLIC WORKS DEPT., WATER DIVISION, Boston, Massachusetts
DEPARTMENT OF PUBLIC WORKS, DIVISION OF WATER, Buffalo, N. Y.
WATER WORKS DEPARTMENT, Chicago
COLUMBIA WATER COMPANY, Columbia, Pennsylvania
BOARD OF WATER COMMISSIONERS, Detroit, Michigan
CITY OF FREDERICK WATER DEPT., Frederick, Maryland
PUBLIC SERVICE COMMISSION, City of Halifax, N.S., Public Water Supply
WATER BUREAU OF THE METROPOLITAN DISTRICT, Hartford, Connecticut
MUNICIPAL WATER WORKS, Huntsville, Alabama
BUREAU OF WATER, Lancaster, Pennsylvania
CITY OF LYNCHBURG WATER DEPARTMENT, Lynchburg, Virginia
MOBILE WATER WORKS COMPANY, Mobile, Alabama
QUEBEC HYDRO-ELECTRIC COMMISSION, Montreal, Quebec
PUBLIC WORKS DEPT., WATER-WORKS & SEWERAGE DIV., Montreal, Quebec
PENNICHUCK WATER WORKS, Nashua, N. H.
WATERWORKS DEPARTMENT, City of Nashville, Tennessee
DEPT. OF WATER, GAS & ELECTRICITY, New York, New York
DEPT. OF PUBLIC WORKS, BUREAU OF WATER, Philadelphia, Pennsylvania
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Pittsburgh, Pennsylvania
POTTSVILLE WATER COMPANY, Pottsville, Pennsylvania
BUREAU OF WATER, Reading, Pennsylvania
DEPT. OF PUBLIC UTILITIES (WATER), Richmond, Virginia
DIVISION OF WATER & SEWERS, Sacramento, California
WATER & SEWERAGE DEPARTMENT, City of Saint John, N.B.
DEPT. OF PUBLIC UTILITIES, WATER DIVISION, St. Louis, Missouri
WATER DIVISION, DEPT. OF ENGINEERING, Syracuse, New York
DEPT. OF PUBLIC WORKS, Troy, New York
CITY OF UTICA, BOARD OF WATER SUPPLY, Utica, New York
CITY OF WHEELING WATER DEPT., Wheeling, West Virginia
WILMINGTON WATER DEPT., Wilmington, Delaware
WATER DEPARTMENT, City of Winchester, Virginia
WATER DEPARTMENT, City of Winston-Salem, North Carolina
YORK WATER COMPANY, York, Pennsylvania
WATER DEPARTMENT, City of Zanesville, Ohio

TODAY... modernized cast iron pipe, centrifugally cast, is even tougher, stronger, more uniform. *Where needed and specified,* it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout its long years of service.

On its record, CAST IRON PIPE is the world's most dependable carrier of water.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS

Look how this TRADE DARLING MARK cylinder-operated gate valve

...SAVES TIME

...AVOIDS TROUBLE

...CUTS MAINTENANCE

WHERE frequent operation is required... especially in inaccessible locations... Darling cylinder-operated gate valves save time on each cycle of operation. The valve may be operated by air, oil or water. Movement is precise and completely controllable. Action can be either manual or automatic. Control can be either local or remote or both.

Darling's double disc gate valve principle assures tighter closing and longer, service-free life. The fully revolving discs have a wiping action that keeps seat faces clean. The discs seat in a different position with each cycle so that wear is evenly distributed. Available in a broad range of sizes and materials. Write for complete details.

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

Lower left, 50′ digester with PFT Floating Cover. Top right, 2 circular filter beds with PFT Rotary Distributors

Orrville, Ohio once again extends its plant

WITH MODERN PFT EQUIPMENT

In 1952, Orrville expanded its sewage treatment facilities by adding a new trickling filter plant to provide complete treatment for a design population of 15,000. Continuing an association that dates back to 1908, PFT again supplied Orrville with highly developed equipment for effective waste treatment.

A *PFT Rotary Distributor* is installed in each of the two 68′ circular filter beds. These units are ruggedly constructed for long, dependable service. Specially designed spreader jets provide uniform distribution over the entire filter bed area, assuring the most effective treatment.

A complete "Controlled Digestion" system was installed consisting of these items of PFT equipment:

PFT Floating Cover for the 50′ digester to provide positive scum submergence and flexible operation.

PFT Heater & Heat Exchanger to maintain optimum temperature in the digester at all times.

PFT Supernatant Liquor Selector (with Gauge, Sight Glass & Sampler unit) for automatic withdrawal of the best digester liquor.

PFT Cover Position Indicator to tell the operator at a glance the position of the Floating Cover.

PFT Waste Gas Burner to burn off excess gas safely and avoid odor nuisance.

PFT Gas Safety Equipment for maximum protection against fires and explosions.

In keeping with its policy, PFT assisted Orrville's consulting engineers by showing the adaptability of its equipment in meeting specific plant requirements.

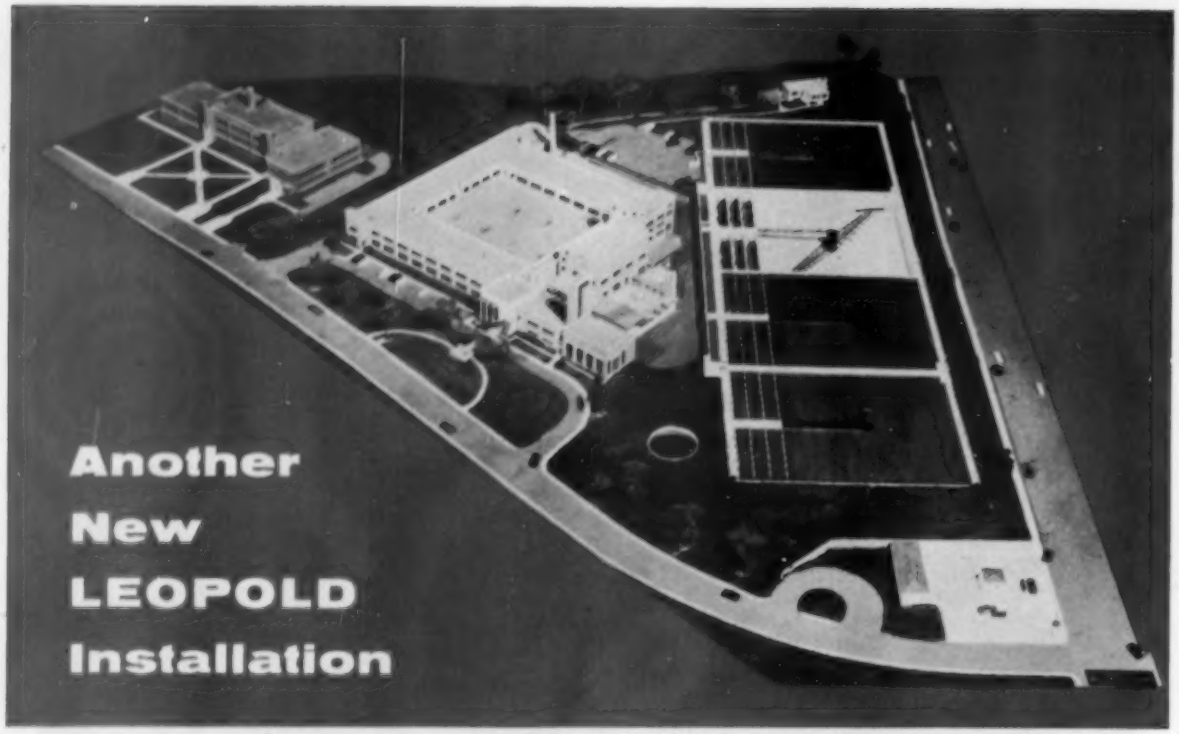
Design of plant by / *Burgess & Niple, Civil & Sanitary Engineers, Columbus, Ohio*

waste treatment equipment exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER



Model of completed Ashburton Filtration Plant. Whitman, Requardt and Associates—Engineers; The Arundel Corporation—Contractors. Built for the City of Baltimore, Department of Public Works, Bureau of Water Supply—Bernard L. Werner, Water Engineer.

Baltimore's Newest Filtration Plant

equipped with

LEOPOLD

Filter Bottoms

Each individual distribution block is about two square feet in area and weighs approximately 100 pounds.

Built to handle a nominal capacity of 120 MGD, the new Ashburton Filtration Plant offers the ultimate in efficient, economical water treatment facilities. For this ultra-modern installation, it's significant, we think, that Leopold filter bottoms are being used—just as they are in over 300 plants throughout the United States. In fact, the five largest municipal filter plants now under construction in this country are all being equipped with Leopold bottoms.

With its many exclusive advantages, the Leopold filter bottom successfully meets all underdrain requirements. Actually, it's the most practical and economical design on the market today. For complete details, write us today. There's no obligation.

Leopold

F. B. LEOPOLD CO., INC.

2413 W. CARSON STREET, PITTSBURGH 4, PA.

COMPLETE WATER PURIFICATION AND SEWAGE PLANT EQUIPMENT • DRY CHEMICAL FEEDERS
FILTER OPERATING TABLES • MIXING EQUIPMENT

MUELLER®

IMPROVED CURB BOX

Telescopic upper section prevents damage to stop, line or box from heavy loads . . . upper section held in any position by strong phosphor bronze spring . . . allows for grade changes, settlement or frost heave . . . cannot be pulled out of base . . . bronze-bushed lid assures easy removal of access plug at all times . . . curb box completely coated with tar base enamel . . . for stops in sizes from ½" through 2" . . . lengths from 2′ through 6′ . . . optional foot-piece centers stop and provides solid support for curb box.

INVERTED KEY CURB STOP

Tapered key individually ground and lapped for perfect pressure-tightness . . . key seated by base cap *and* water pressure . . . increase in water pressure automatically increases key-seating force . . . key is unseated for easy turning with downward pressure on shut-off rod . . . pressure instantly reseats key . . . combined cap and tee has accurate built-in check . . . all parts cast from finest waterworks bronze . . . various combinations of inlets and outlets for any type, or types, of service pipe . . . sizes from ½" through 2".

See your Mueller Representative, Catalog W-96 or write direct for detailed information on Mueller's full line of curb stops, curb boxes and related waterworks products.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

When you buy HYDRANTS and VALVES for your city waterworks system...

LOOK TO THE YEARS AHEAD, TOO!

EDDY can supply replacement parts for any Eddy Valve or Hydrant ever installed! This is important to you because the Valves and Hydrants you buy today must serve several generations yet unborn. You want no "orphans" in your system. Eddy Hydrants and Eddy Valves are backed by Eddy Valve Company's 104 years of dependable operation—your assurance that replacement parts will be available during the years to come.

EDDY Bronze-Mounted HYDRANTS

are built for dependability and lasting service. They open smoothly *with* the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Positive drip action automatically drains the standpipe, safeguarding against freeze-ups. Stem held in place below main valve means no water loss due to a bent stem.

EDDY Bronze-Mounted GATE VALVES

offer simplicity of design, trouble-free operation and enduring service. From the engineering drawing boards through all stages of manufacture, they are step by step a truly "finished" product of workmanship. These factors, added to personal experience, are reasons why progressive water works men have relied on Eddy Valves for years.

Eddy Hydrants and Valves are available with bell, flange or mechanical joint connections to fit any existing or planned installation.

Send today for full information on the complete line of Eddy Valves and Hydrants. No obligation.

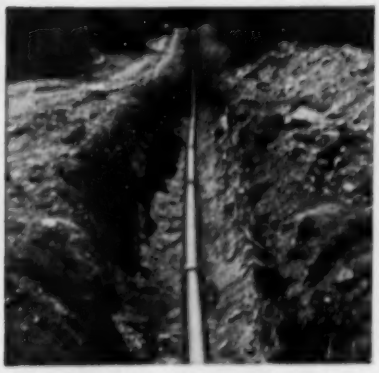
EDDY VALVE COMPANY

A Subsidiary of James B. Clow & Sons

WATERFORD, NEW YORK

Seafaring durability! K&M "Century" Pipe "goes to sea" on the Padre Island causeway pictured here. The island is located off the Texas mainland. Engineers: Parson, Brinckerhoff, Hall and Macdonald, New York. Installation contractor: W. T. Liston Co., Harlingen, Texas. Photo by Booth Studio.

In the South! "Century" Pipe is shown here at the beginning of the Padre Island causeway—a span that stretches out from the coast of Texas into the Gulf of Mexico for a mile and a quarter.



In the east! This picture illustrates an installation of "Century" Pipe at the Brookwood Estates, Stanhope, New Jersey.

Over the Sea, as across the Land

K&M "Century"® Pipe Keeps Pumping Costs Low!

Off the coast of Texas, the "Century" Pipe on the causeway pictured above prevents pumping costs from creeping up—there's never a change in the diameter of its bore! Why? This asbestos-cement pipe is non-tuberculating, highly resistant to corrosion, and immune to electrolysis.

Formed on a smooth steel mandrel, its interior surface offers a minimum of friction. The Williams and Hazen Constant "C" is conservatively placed at 140. As this pipe is relatively light in weight, handling and installation costs are low. It also meets the A.W.W.A., and A.S.T.M., and Federal specifications for asbestos-cement pressure pipe.

Contraction, expansion controlled. The "Century" Simplex Coupling acts as an expansion joint. Each pipe length "floats" within its own couplings. Thus, any contraction or expansion need is readily met. Furthermore, these couplings actually absorb traffic vibration.

Booklet on request! Write for your copy of "Mains Without Maintenance" . . . complete specifications and background data for K&M "Century" Pipe. There's no obligation, of course.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

K&M best in asbestos®

ACT NOW!

eliminate "orphans" from your fire protection system . . . with

IOWA

GATE VALVES and FIRE HYDRANTS

Don't Gamble on Obsolete Equipment

...BE READY FOR ANY EMERGENCY!

"Forever" is such a long, long time. In this H-bomb age, we hesitate to promise that replacement parts for Iowa Hydrants and Gate Valves will be available "forever." But we'd like to—because, actually, replacements are readily available today for every part of every hydrant and gate valve Iowa ever has made. That's a record that extends way back to 1909—almost a half century ago. It's a record we plan to maintain. So, this much we can say: You're as "safe as safe can be" in replacing NOW with time-proved Iowa. For full details, please write TODAY!

IOWA HYDRANTS

Provide full, truly unrestricted water way.

Open with the pressure for faster water delivery.

Close *against* the pressure to eliminate water hammer, provide flushing action.

Assure positive drainage.

Are available for any type of connection.

All working parts removable through top—no digging or special tools required.

Meet all A.W.W.A. specifications.

IOWA GATE VALVES

Double disc, parallel seat.

Positive wedging action for efficient, no-leak closing.

Gates hung loosely from stem nut—no binding.

Rugged, time-proved design means long life, low service costs.

Available with bell, flange, or mechanical joint connections to fit any existing or planned installation.

Meet all A.W.W.A. specifications.

IOWA VALVE COMPANY

Oskaloosa, Iowa • *A Subsidiary of James B. Clow & Sons*

FAMOUS LIGHTHOUSES OF AMERICA

Fowey Rocks Lighthouse is situated on the outer reefs 11 miles southeast of Miami, Florida. Built in 1878, it is of iron pile construction and stands in 4 feet of water with the light itself 110 feet above water. Fowey Rocks Lighthouse is one of a series of great offshore lighthouses that have made navigation safer and helped to eliminate an infamous wrecking industry that once thrived along the dangerous Florida Reefs.

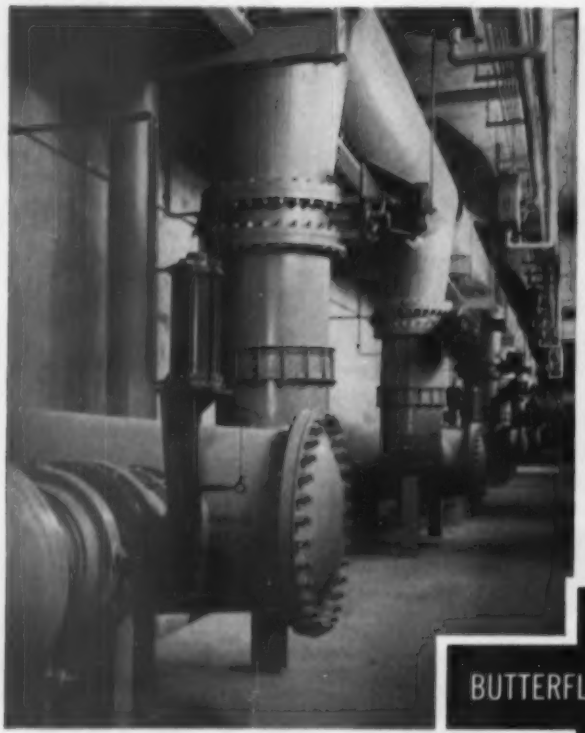
Greater Safety and true guidance in the use of electrochemical products have always been important factors in the service Niagara Alkali Company offers to its customers. You can always depend on the quality of Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Paradichlorobenzene, Nialk Caustic Soda, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride).

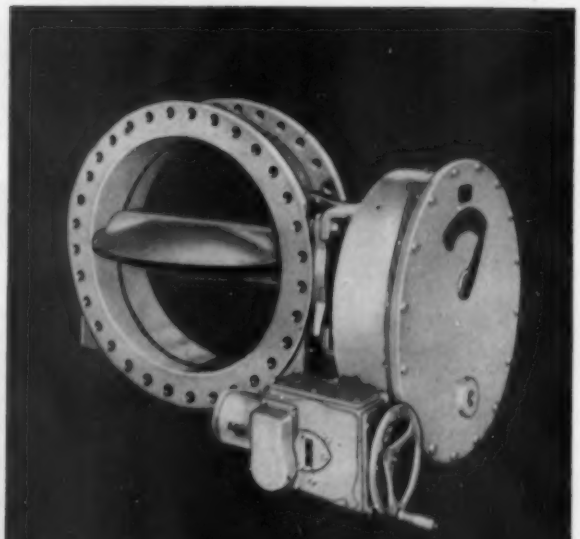
NIAGARA ALKALI COMPANY

60 East 42nd Street

New York 17, N.Y.

DROP-TIGHT SHUTOFF R-S Rubber-Seated Butterfly Valves give drop-tight closure to 125 psig through wedge-type action of the disc within a one-piece rubber seat. 65 of these valves, installed as shown for service in the San Jacinto River project near Houston, gave a substantial space reduction and direct, in-place cash savings of $124,000.





FOR HIGH-PRESSURE SERVICE SMS Babbit-Seated Butterfly Valves are built to give tight shutoff and meet the rugged demands of high-pressure service. They are available for shutoff pressures up to 200 psig, and for a wide range of velocities, including open-end free discharge.

BUTTERFLY VALVES

GET POSITIVE SHUTOFF, CUT CONSTRUCTION COSTS

For high or low-pressure water service, SMS has the Butterfly Valve to give you tight shutoff and help reduce construction costs. Using SMS or R-S Butterfly Valves in place of conventional gate valves permits a much more compact piping layout, means substantial savings in the initial building costs. For full information on the complete SMS valve line – Butterfly Valves, Ball Valves and Rotovalves – see our local representative or write S. Morgan Smith Co., York, Pa.

HYDRAULIC TURBINES
PUMPS
GATES & HOISTS
TRASH RAKES
ACCESSORIES

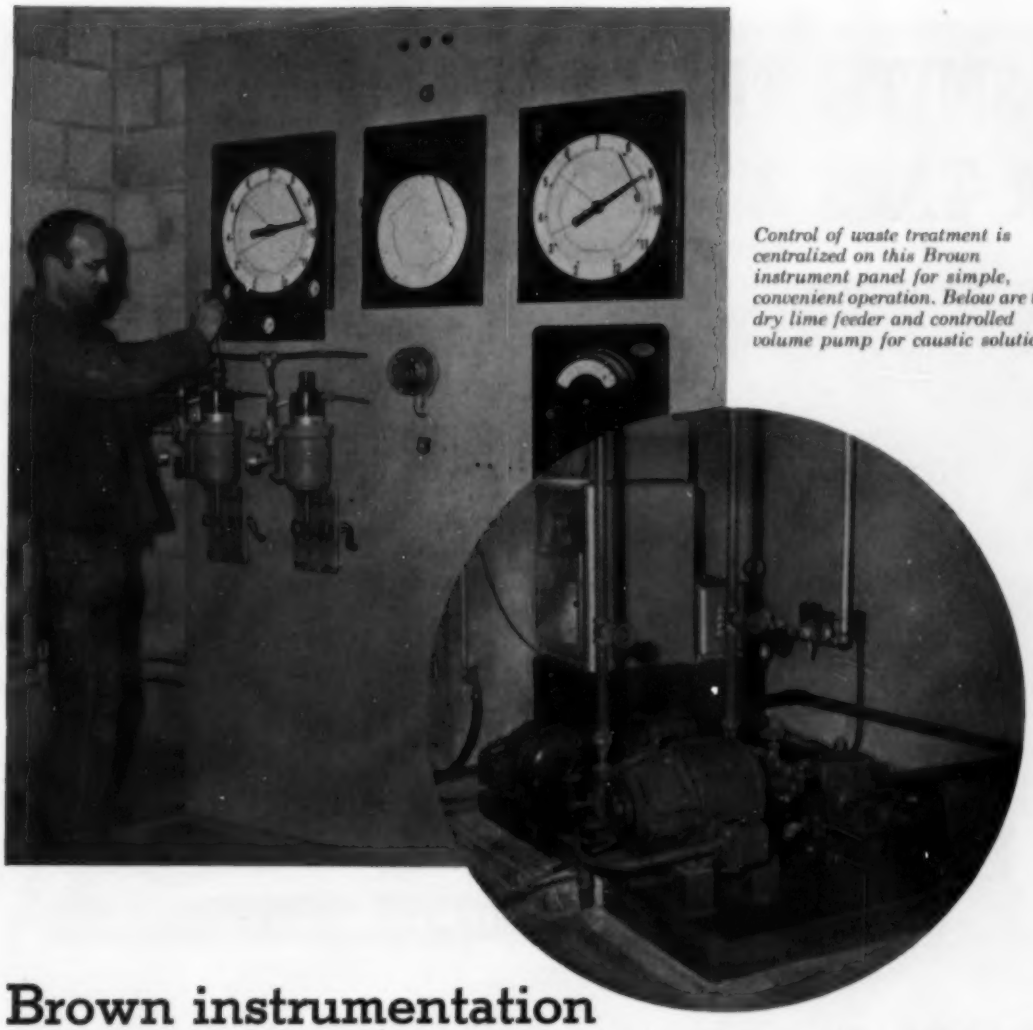
HYDRODYNAMICS

ROTOVALVES
BALL VALVES
BUTTERFLY VALVES
FREE-DISCHARGE VALVES
CONTROLLABLE-PITCH SHIP PROPELLERS

SMS

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED • TORONTO



Control of waste treatment is centralized on this Brown instrument panel for simple, convenient operation. Below are the dry lime feeder and controlled volume pump for caustic solution.

Brown instrumentation *helps change plant waste to safe effluent*

Acid wastes from various metal-working operations are converted into neutral effluent, in the waste treatment facilities at General Electric's manufacturing plant at Allentown, Pa. Designed by Gilbert Associates, Inc. in cooperation with G.E.'s own water management and waste control engineers, the system features automatic control of reagent feed and continuous recording of operating data . . . by means of Brown instruments.

To bring wastes to the alkaline side, an *ElectroniK* pH recorder with pneumatic control regulates both a lime dry feeder and a variable volume pump for caustic solution. The proportional control system accurately adjusts reagent in relation to the amount of neutralization required . . . to assure both economical usage of chemicals, and complete safety of effluent.

Additional instrumentation provides a permanent, detailed record of overall system performance. A Brown flow meter, electrically connected to a float actuated transmitter at a weir some 100 feet from the panel, measures the flow of treated water discharged. A second *ElectroniK* pH recorder checks the final effluent.

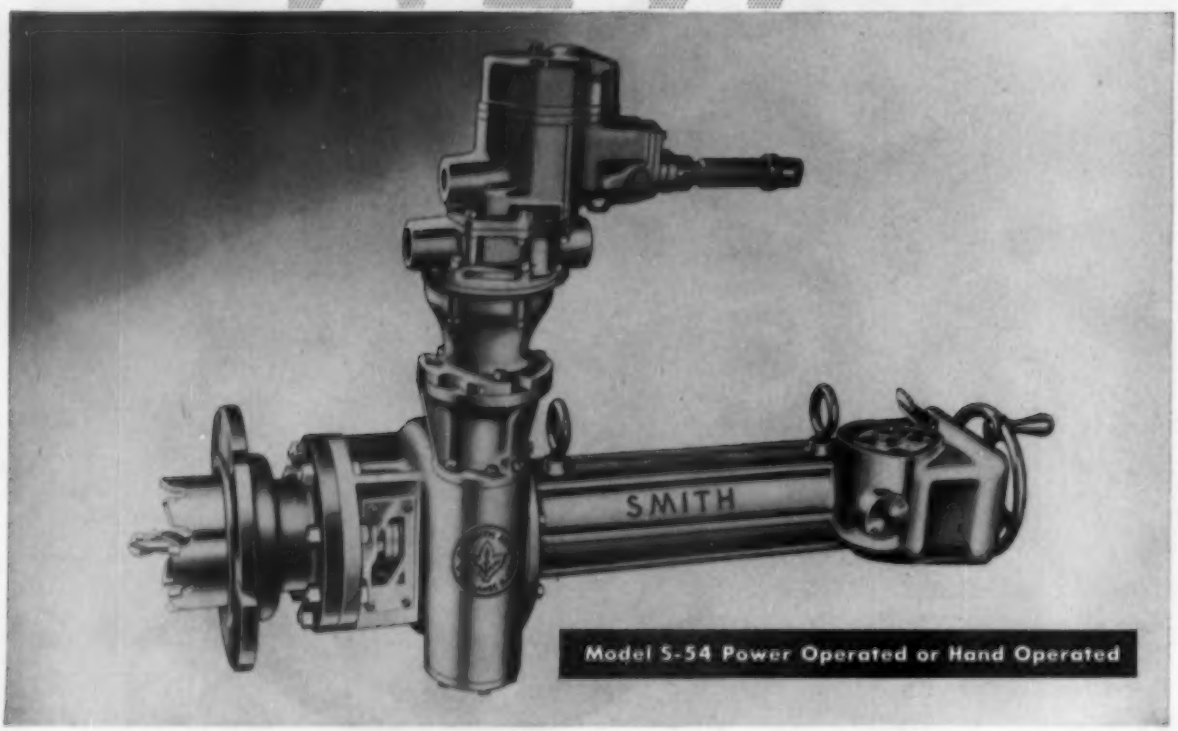
For control of treatment process for industrial wastes, sanitary wastes and water supplies, Honeywell offers a comprehensive line of instrumentation . . . and a background of long engineering experience. Your local Honeywell sales engineer will be glad to discuss your specific project with you and your consulting engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA:**
Write for Data Sheets No. 9.6-5a, "Dry Feed System"... No. 10.3-4a, "Float Actuated Meters"... and No. 11.12-1, "Automatic Sequence Control."

MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls

NEW SMITH TAPPING MACHINES FOR TAPS 2″ THRU 12″ INCLUSIVE



The A. P. Smith Mfg. Company in 1896 introduced the first Tapping Machine for making connections sizes 2″ and larger to fluid and gas service piping under pressure. The *NEW* Smith S-54 Tapping Machine is the most modern, efficient and economical machine available. The S-54 Smith Tapping Machine is used with Tapping Sleeves, Hat Flanges, Saddles and Tapping Valves to make 2″ through 12″ connections under pressure to Cast Iron, Cement-Asbestos, Steel and Reinforced Concrete Pressure pipe. 1. AUTOMATIC FEED: Positive automatic feed insures correct drilling and tapping rate. Hand feed is provided to rapidly advance and withdraw Cutter. 2. TRAVEL INDICATOR: Chart attached to machine indicates travel required to complete tap. Travel is *AUTOMATICALLY* terminated when tap is completed. Cutter and shaft cannot overtravel. 3. COMPACT CONSTRUCTION: Telescopic shaft reduces overall length. 25″ travel is adequate for 2″ through 12″ taps to any size of pipe. 4. ENCLOSED CONSTRUCTION: Mechanism is housed in heat treated Aluminum Case filled with lubricant. Foreign matter cannot enter and damage mechanism. 5. STUFFING BOX AND PACKING GLAND: Accessible without disassembling machine. Equipped with Chevron packing. Line pressure cannot enter machine case. 6. RUGGED CONSTRUCTION: Extra large diameter telescopic shaft adds strength and rigidity. Timken radial—thrust bearings maintain alignment, reduce friction and wear. 7. DRIVING GEARS: Worm gearing operates in lubricant, torque is reduced to the minimum. 8. CUTTERS: Have replaceable Flat and Semi-V alternate teeth of High Speed Steel or Tungsten Carbide. 9. FLEXIBILITY: Hand Operated Machines can be converted to Power Operation by interchanging worm gearing. 10. AIR MOTOR: The motor attaches directly to the Power Operated Machine without Brackets, Holders, Adapters or Couplings. Bulletin sent on request.

52

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

NOW...waste treatment is "packaged" for you!

An industrial waste treatment plant...complete in a package...that's the great, new, efficient answer developed by CHAIN Belt to clarify plant water, eliminate pollution and reclaim process water and valuable materials. The new Rex® Steel Tank Verti-Flo® is shipped ready for use...just pipe it into plant sewer lines.

Bulletin No. 315-92 gives you all the facts...shows you how simple and efficient this new unit is. It shows why the Verti-Flo design is ideal for industrial waste treatment with its ability to cut detention times...reduce tank sizes ...assure maximum clarity. It illustrates the flexibility of Verti-Flo®...how it can be easily arranged to recover valuable materials and simplify disposal of waste solids.

Send for your copy today and also informative booklets on the other Rex equipment for efficient waste treatment. Simply mail the coupon. There is no obligation.

CHAIN BELT COMPANY

Milwaukee 1, Wisconsin

CHAIN Belt Company
4610 W. Greenfield Ave. 55-211
Milwaukee 1, Wis.

☐ Send me my copy of Bulletin No. 315-92 on Packaged Verti-Flo Clarifiers.

☐ I would like data on other Rex waste treatment equipment.

Name.....

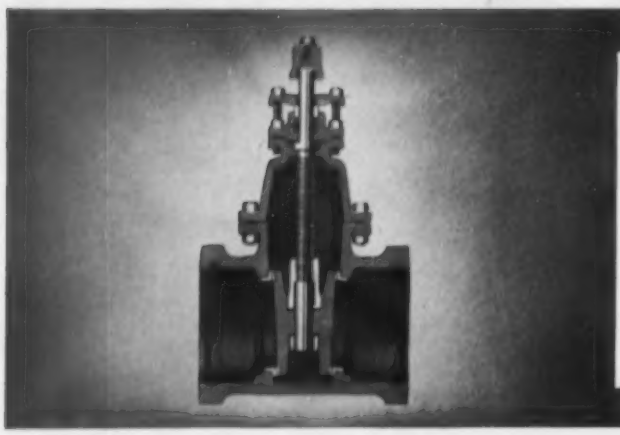
Title.....

Address.....

City.....*Zone*....*State*.....

R. D. WOOD GATE VALVES PROVIDE POSITIVE FLOW CONTROL AFTER YEARS IN THE LINES

Here's what the R. D. Wood Gate Valve looks like from the outside — rugged, simple, streamlined. It is built for generations of dependable service in the lines. Available with all pipe connections, including mechanical joint.



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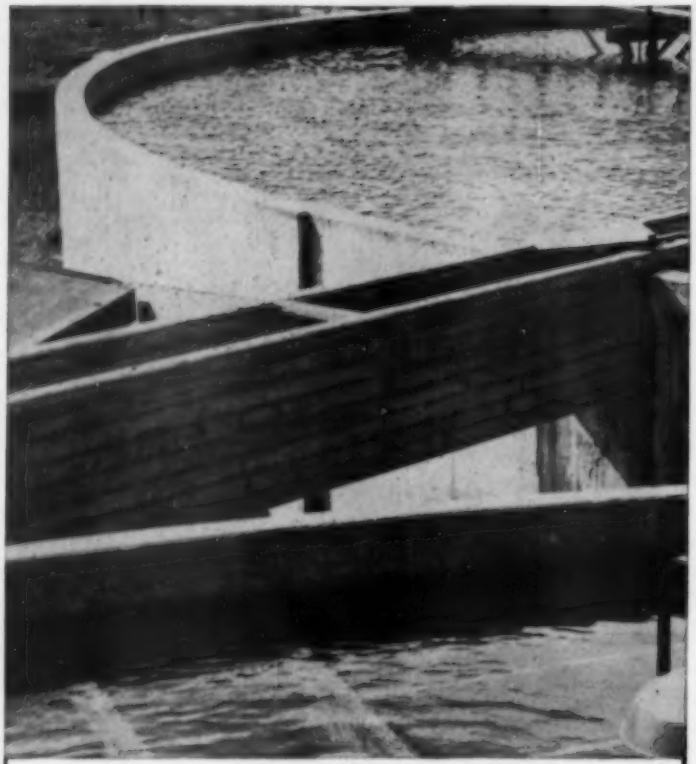

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BOSTON—Coleman Brothers Corp. laid this line of 60-in. ID tar-enameled and wrapped Bethlehem Pipe along the Charles River. The bridge leads to Harvard University. This job, as well as the two shown below, is a project of Boston's Metropolitan District Commission.

EAST MILTON—Southeast of metropolitan Boston, Marinucci Brothers and Co., Inc., is installing 24-in. Bethlehem Pipe. The twin lines shown here bridge the Southeast Expressway, a high-speed artery now under construction.

DEDHAM—These 40-ft lengths of Bethlehem Pipe, 36 in. ID, are part of an 11,500-ft line between Dedham and West Roxbury, southwest of Boston. Chesterbrook Construction Co. is handling installation of the project.

Bethlehem Steel Pipe for water and sewage transmission is available in 40-ft lengths, coated, lined and wrapped, in all diameters from 18 in. to the largest permitted by common carriers. For further information, we suggest you contact the Bethlehem sales office nearest you.

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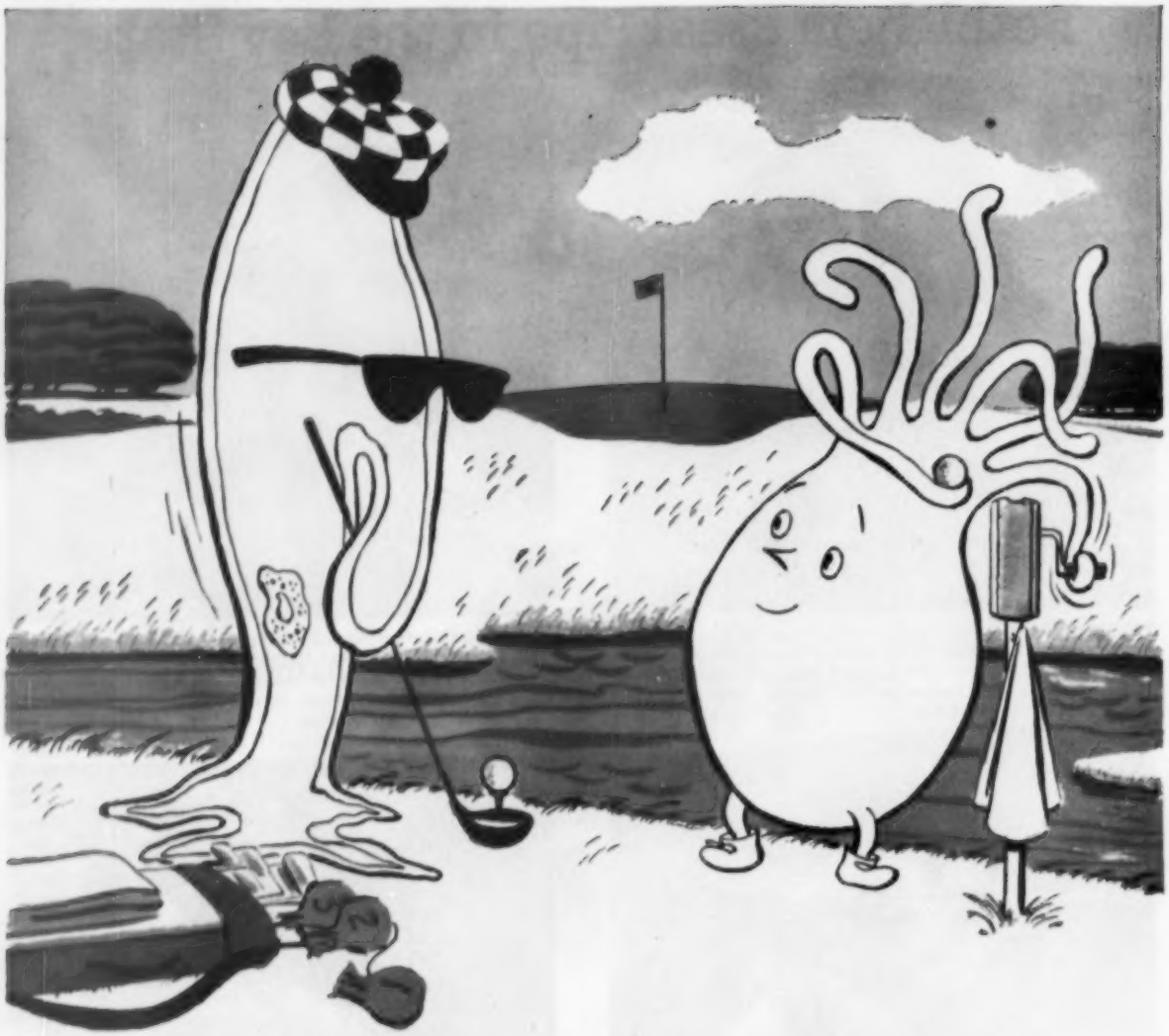

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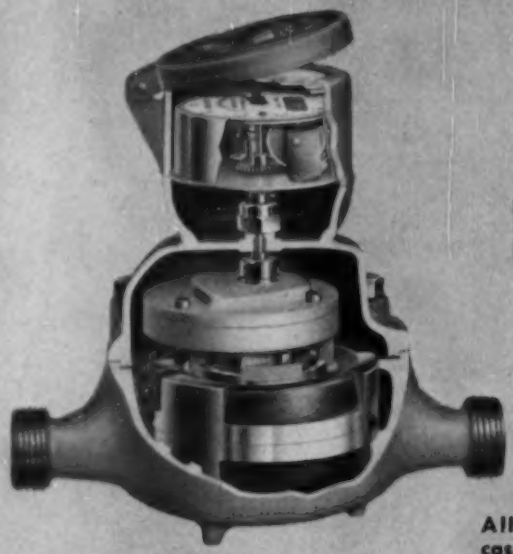
Little Things Mean A Lot

in Rockwell Disc Meters



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Many potable waters are corrosive to meters—some more so than others. Rockwell guards its Arctic and Tropic meters against corrosive attack through the use of carefully selected and treated stainless steel at such vulnerable points as the division plate, driving dog, disc spindle, stuffing box spindle and screws.

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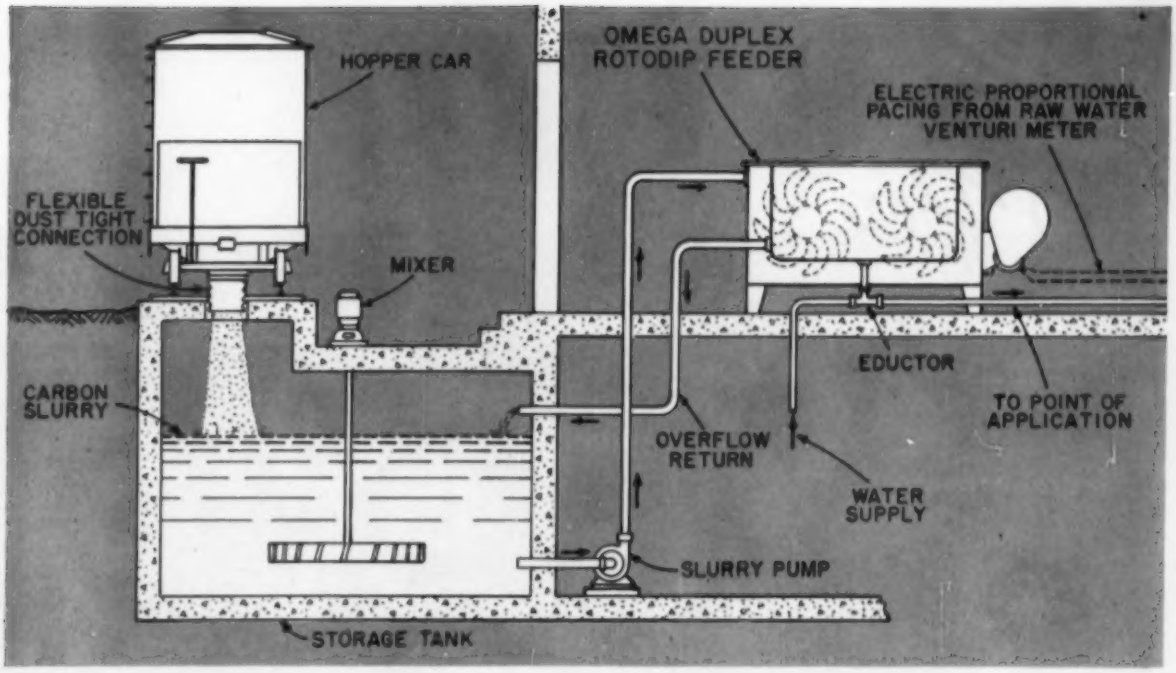

Houston shows how to cut carbon handling costs

Activated carbon for controlling the taste and odor of Houston's water supply is received in carload lots at the Houston Water Purification Plant. As shown in the diagram, the carbon is then fed in slurry form by Omega Rotodip Feeders, the super-accurate solution feeders which are specially designed for this type of service. Here are the advantages of this modern chemical feeding system:

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2. **Reduced construction costs**—system permits below-ground storage.
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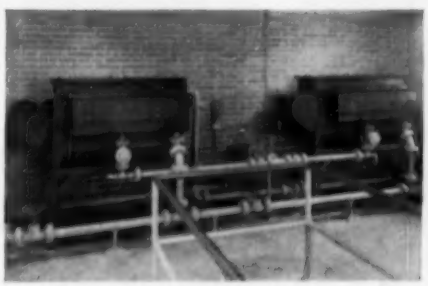
Carbon slurry feeding is another example of how "The Last Word in Feeders" save money in the feeding of chemicals. For further information on this and other advanced types of dry and liquid chemical feeders, write Omega Machine Company, 350 Harris Ave., Providence 1, Rhode Island.



Omega Duplex Rotodip Feeders for feeding and metering carbon slurry at Houston Water Purification Plant. This plant also employs Omega Gravimetric Feeders for alum, ferriflor, quicklime, and soda ash.

Chemical Building which houses Omega Rotodip Feeders. Arrows point to railroad siding and storage tank covers. Plant engineering was by Freese, Nichols & Turner — of Houston, Texas . . . installation by E. W. Bacharach, Inc., Kansas City, Mo.

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WATER & SEWAGE WORKS

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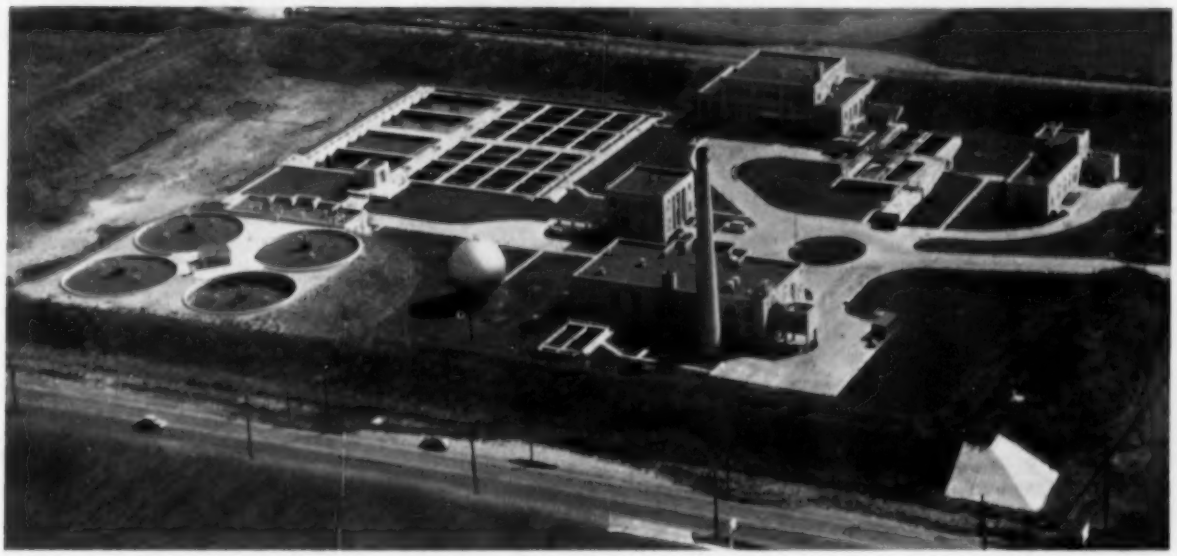


SLUDGE DIGESTION facilities are at far left in this view of Cincinnati's Little Miami sewage treatment plant

How to Avoid Sour Digesters

A "case history" report of difficulties encountered in early sludge digester operation at the Little Miami plant, Cincinnati's first in an extensive metropolitan program

by DAVID P. BACKMEYER

Mr. Backmeyer is Superintendent of the Little Miami sewage treatment plant at Cincinnati, Ohio. In this article he describes in detail the steps required to obtain satisfactory sludge digestion after poor digestion had resulted during start-up of the plant.

ABOUT one month after Cincinnati's Little Miami sewage treatment works was first placed in operation, the question was asked at a meeting of sewage works operators: "How do you propose to start up your digesters, and how soon will you have gas of usable quality?"

The answer to the inquiry consisted of a plan for starting the digestion system at the Little Miami plant. When put into actual practice, however, the plan proved to be an utter failure.

It is the purpose here to relate some of the experiences encountered in attempting to get the sludge digesters in proper operation, to point out if possible why the original plan failed and, most important of all, to suggest an applicable method for starting new digesters.

As the title of this article indicates, it is of prime importance to the plant operator to avoid sour or acid digestion tanks. When it became evident at the Little Miami plant that serious digestion trouble was at hand, an effort was made to find in published reports and sewage works literature some record of experience or suggested practice that might offer a direct solution to the problem. Not much of practical value was found.

Limited information, pertaining principally to laboratory-scale work, did not seem to offer much help. It became apparent that the "stuck" digesters were not to be brought into line by over-night operational changes. Finally, with the aid of technical assistance offered by several authorities on anaerobic digestion from outside the city's operational forces, a plan was devised that ultimately led to a solution to the problem.

Perhaps the first part of this discussion might well be titled "How *not* to start a sewage sludge digestion system." As previously noted, the original plan of operation was a complete

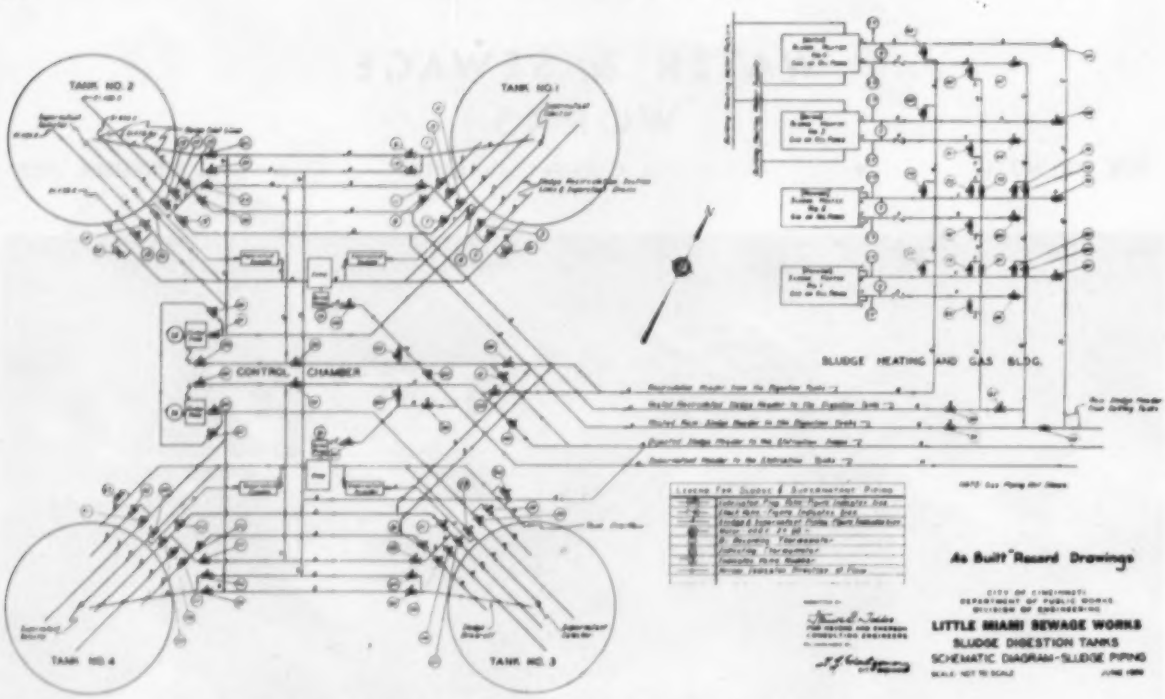


FIG.—SCHEMATIC diagram of sludge piping shows excellent flexibility built into digester system

failure. It contained several basic defects. This plan, however, is described in some detail so that other operators may profit from the experience gained.

Sludge Digestion Arrangements

The Little Miami plant is basically a primary treatment works. Provision is included to augment this treatment by addition of chemicals to the raw sewage should the condition of the receiving stream require a more highly purified effluent than that obtained from plain sedimentation.

The sludge solids are digested and the gas is utilized for heat. Final disposal of solids is by burning in the incinerators. As this discussion is concerned chiefly with the digestion of sludge solids, this facility will be described in some detail.

Raw sludge may be pumped from the primary tank sludge hoppers to any one or a combination of the four digesters provided. The four digestion tanks are identical in design, 65 feet in diameter with 26-foot sidewall depth, and equipped with insulated floating covers and gas collection equipment. The nominal holding capacity of each tank is 80,000 cubic feet, or 600,000 gallons.

Proper digestion temperatures are maintained by passing the raw sludge and/or the tank contents through external heaters and heat exchangers fired by either oil or sewage gas. Figure 1 illustrates the piping arrangement available for heating and mixing the digestion tank contents. Figure 2 shows a typical cross-section of one of the digesters. With such an elaborate control system at one's disposal, the probability of having serious digestion troubles would at first appraisal seem very remote.

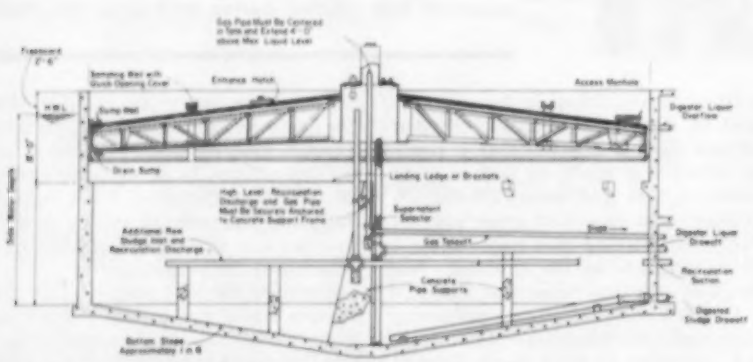


FIG. 2—TYPICAL cross-section of Little Miami digesters

Original Start-Up Plan

Based on experiences encountered in starting sludge digesters at two other treatment plants—namely Richmond and Marion, Indiana—a starting-up operation scheme was devised utilizing the full capacity of the four digesters, but operating in two stages so that all of the raw solids were pumped first to one or the other of two tanks designated as primary digesters. When necessary, transfer of top liquor was made from a primary digester to its companion secondary tank.

Temperatures were controlled at 90° to 95° in the primary tanks only. Oil was burned in the external heaters to pre-heat the incoming raw solids and to increase the temperature within the tanks by circulation of the tank contents when required.

The quantity and quality of the gas produced was calculated daily. After

about 30 to 60 days time a normal change from acid digestion to balanced normal digestion was anticipated.

Not too much concern was given to low pH during the first 40-day period. Volatile acid concentration was to be logged after active gas production was indicated. Should foaming occur, feed of fresh solids was to be discontinued until excessive activity had subsided. Normal digestion routine was then anticipated.

Initial Period

The first raw sludge was added to the No. 1 primary digester on November 6, 1953. During the month prior to this date, the construction project contractor was engaged in final testing of digester tank floating covers and accessory piping and valves. City water was used for testing the floating covers and piping.

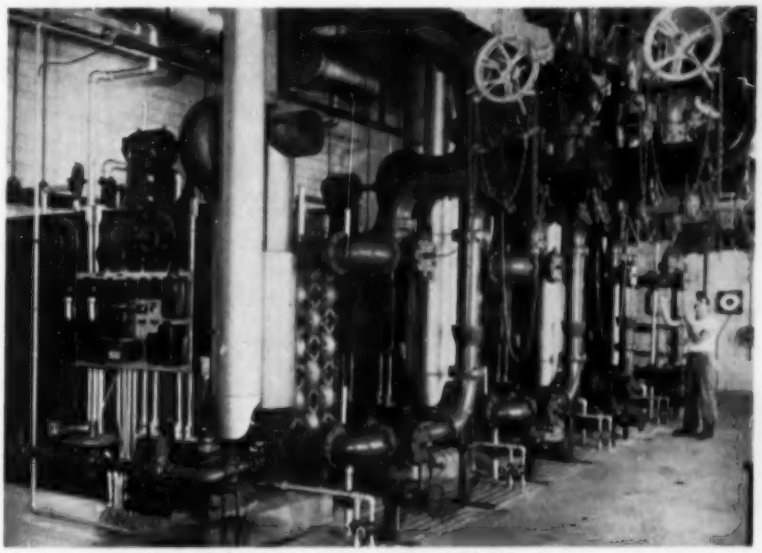
When fully tested and approved, the digesters were brought up to 80° by circulating the test water through the sludge heaters. When sludge from the settling tanks was added, heating was continued until both the primary digesters (designated as tanks 1 and 3) were at 95° F. This required about 12 days' time. The system was then considered ready to receive the daily raw sludge solids.

The raw sludge as pumped to the digesters averaged 8.15 per cent total solids for the 24 days of November. The volatile content of this sludge averaged 67.8 per cent. Each of the primary digesters was being fed 9100 pounds of solids per day, or at an equivalent rate of 3.41 pounds solids per cubic foot of digester capacity per month. The volatile loading was 2.32 pounds of volatile solids per cubic foot per month.

During the next month, December, the average solids load processed through the digesters continued at about the same rate; for example, 9200 pounds of solids per day to each tank and with volatile content of 67.0 per cent.

On December 10, the operational routine was interrupted while the contractor made necessary changes in the sludge sampling pipe lines. In order to complete this work, each of the four digesters was successively drained by transferring its contents to the other three tanks. This resulted in a well-mixed digestion system, in which the two-stage characteristics of the primary and secondary tanks were completely lost. While these transfers were being made, the raw sludge was added daily to whichever tank had available capacity.

With this work completed, raw sludge additions were again made to each of the two primary digesters on an alternate daily schedule. Supernatant displacement liquor was drawn to the secondary digesters and returned to the plant raw sewage wet well.



SLUDGE HEATING units utilize either digester gas or oil

The sewage gas production record for the 33-day period from December 30, 1953, through January 31, 1954, is indicated in Fig. 3. The two digestion systems—namely, primary digester No. 1 with its secondary tank No. 2, and primary digester No. 3 with its secondary tank No. 4—were giving a satisfactory and consistent quantity of gas in direct response to the time of feeding on the alternate daily schedule. Particular attention is directed to the indication on Fig. 3 as to the volume of gas being produced. Both thousand *and* hundred cubic feet are used. At this time the volumes were read and recorded on the thousands scale, shown "as metered" (clarification is made in a later explanation).

Sour Digestion

It is important to note at this point that the first check of volatile acid concentration in the two primary digesters was made on December 10, about 34 days after the first introduction of raw sludge to these tanks. The results were alarming and of considerable concern. The No. 1 digester at 5,000 ppm, and the No. 3 tank at

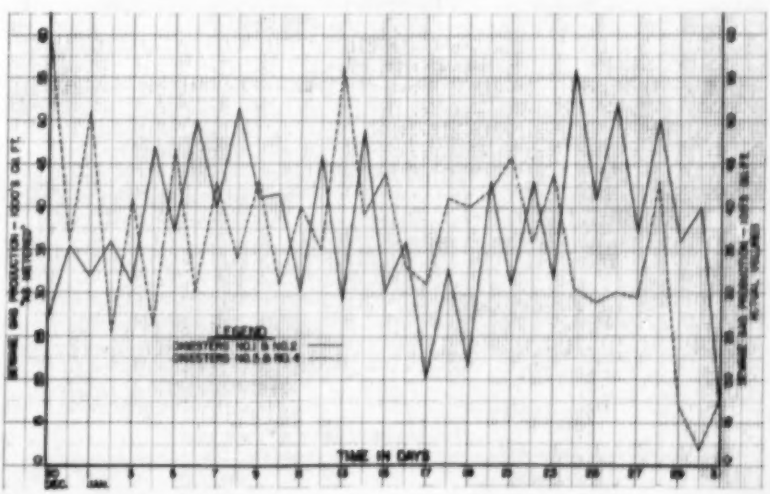
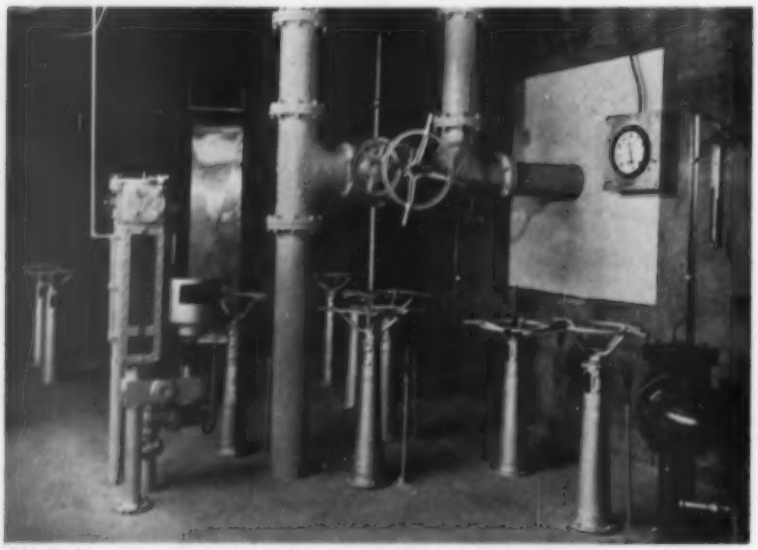


FIG. 3—GAS production during 33-day period ending January 31, 1954



CONTROL equipment for each digester provides operational flexibility

4,000 ppm, certainly indicated the presence of volatile acids far above desirable limits. The gas being produced contained carbon dioxide in excess of 70 per cent by volume.

Figure 4 shows the trend of pH, volatile acids, gas CO_2 content, tank temperature, and gas production for the No. 3 primary digester from December 20 through February 24. It may be summarized as carbon dioxide above 80 per cent with pH at 5.3, but with satisfactory gas yield.

The principal concern at this time was the extremely high carbon dioxide content of the gas being produced. Beginning on January 27, and continuing for a period of 14 consecutive days, hydrated lime slurry was added to this digester. The average rate of lime addition was 2140 pounds of hydrate daily, or an equivalent of 300 ppm of calcium oxide.

Direct chemical combination of the calcium hydroxide with the CO_2 resulted in the gas production drop as shown in the graph. Corresponding pH fluctuation also followed the trend of the lime additions. Volatile acid concentrations were above 7,000 ppm throughout the last 30 days of this period.

In evaluating the brief period of lime treatment, it became obvious that the results did not warrant the cost of the chemical added. It was also believed that to continue the previous schedule of feeding raw sludge to the tanks would lead to even higher, undesirable acid concentrations.

On February 15, the condition of the sludge digesters was described by telephone to Harry Schlenz, President of the Pacific Flush Tank Company, and to Frank Woodbury Jones, of Havens and Emerson, consultants for the city. A conference was arranged to further examine the operational data and to suggest desirable changes in the method of operation.

It was agreed that the one favorable feature of the existing situation was that apparent large quantities of gas were reported as being produced. This was an indication of vigorous activity within the primary digesters, despite the fact that the gas being produced was extremely high in carbon dioxide and could not be burned.

As an immediate change in operation, primary digester No. 1 and its companion secondary tank, digester No. 2, were separated from the regular routine and placed on limited reduced feed as individual digesters, in contrast to the previous stage operation. The raw sludge added to these two digesters was now reduced to about one-sixth the amount normally fed daily. Temperature was held at 85°. Volatile acid, total alkalinity and pH were observed on a regular schedule.

Excessive raw sludge (that which was not pumped to digesters 1 and 2) was added daily to the other two digestion tanks. This procedure was followed for three weeks, but little or no improvement was observed.

Because of the reduction in raw solids being fed, the amount of gas produced daily was lower than during the previous operating period. There was no indication that either of the two tanks were making a turn toward methane fermentation. The serious-

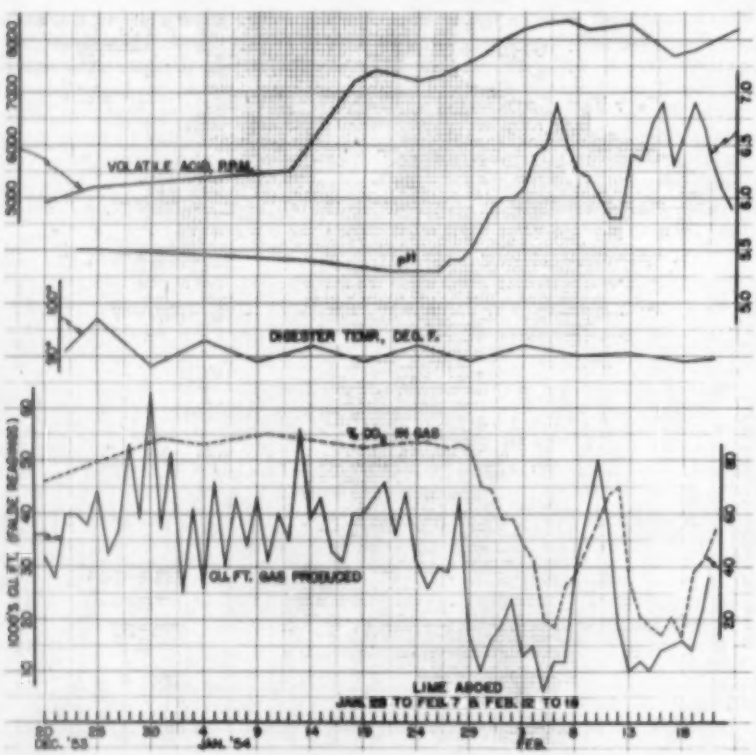


FIG. 4—GAS production during sour digester operation, 44th to 107th day

ness of the problem was becoming acute.

At the suggestion of A. D. Caster, Principal Engineer of the Sewage Disposal Section, a second "council of war" was called on March 11, at which time Mr. Schlenz invited Dr. A. M. Buswell, Illinois State Water Survey, Urbana, Illinois, to review the operations and explore further any possible solution to the "sour digester" problem. Mr. Jones assisted in reviewing the additional operational data, particularly for the period when the two digesters had been on limited feed of raw sludge.

Gas Measurement Error

Dr. Buswell expressed great interest in the apparent high rate of gas production which, as reported, was in the order of 10 cubic feet per pound of volatile solids added. This indicated that the fermentation of organic matter to acetic acid was being successfully carried out, with a high concentration of volatile acids in the tank contents. He indicated that in his laboratory experiments he had not been able to carry acetic acid fermentation for long periods, despite pervious desires to continue this fermentation in order to recover acetic acid from organic matter.

He also stated that best results in acetic acid production resulted from the addition of lime. Without lime the methane fermentation was favored. With the exception of the high gas yields, all other pertinent conditions added up to a typical "sour digestion" condition.

Dr. Buswell noted that for a selected period the carbon dioxide corrected for air oxygen plus the volatile acid calculated as acetic acid, equaled 50 per cent of the weight of the volatile matter added. Sludge measurements, however, indicated 30 to 35 per cent digestion of volatile solids.

This discrepancy pointed toward an observational error of considerable magnitude. He further suggested that if there was an error in the decimal point of the gas yield, the data would present a typical "sour digestion" picture.

An "on the spot" inspection of the gas meter recording dials revealed (after verification with the Cincinnati Gas Company) that actually a tenfold error was being recorded daily in reading the gas meter. It is a gross understatement to say that this significant fact put new light on the entire picture, and the author can vouch for at least one red face at the conference table.

Correctional Efforts

Plans to proceed were now geared to the realization that we had a group of four sour digesters on hand, any one of which was capable of producing, at best, only a dribble of gas —and that extremely high in carbon dioxide. Of the several possible methods of procedure explored that seemed likely to get the tanks transformed to methane production, two were selected as being the most practical and were to be given a trial.

One plan called for isolation and complete cleaning of one digester, then placing the tank back in operation under controlled feed with daily volatile acid concentration tests used as control. Digester No. 2 was selected for this.

The other plan called for the continuation of a watchful, waiting, program for digester No. 1, with daily observations to note any sign of a favorable trend to methane digestion.

In actual practice, it was possible to give both plans a trial simultaneously.

The No. 1 digester was maintained at 85°, and was to be given a predetermined limited raw solids feed for a reasonable period of time, perhaps about two weeks. If within this period a change of favorable magnitude did not occur, other appropriate action was to be taken.

In brief summation, digester No. 1 did not respond to the prescribed treatment. It was nurtured, checked, and double checked for a period of 60 days. The CO_2 of the gas held consistently above 75 per cent. Volatile acids continued at high concentrations (above 6500 ppm). There was no evidence of change to methane production. The activity in the tank, as indicated by production of gas, also came to a gradual end when the additions of fresh solids were discontinued for a period of about three weeks.

No. 2 Re-Started

The No. 2 digester was cleaned out completely on March 14. A fire hose was used to wash down the side walls. This was done so that no acid sludge would remain that might serve as seeding material to contaminate the new starting-up program outlined for this tank.

As an added precaution, and at the suggestion of Dr. Buswell, the raw sludge fed to the clean digester was to be kept free of recycled liquor and sludge from the other digestion tanks. This precaution would prevent intense reseeding of the raw sludge with undesirable acid-producing organisms, which were in the other digesters in high concentrations. To carry out this precautionary measure, it was necessary to by-pass the treatment plant proper whenever displacement liquids

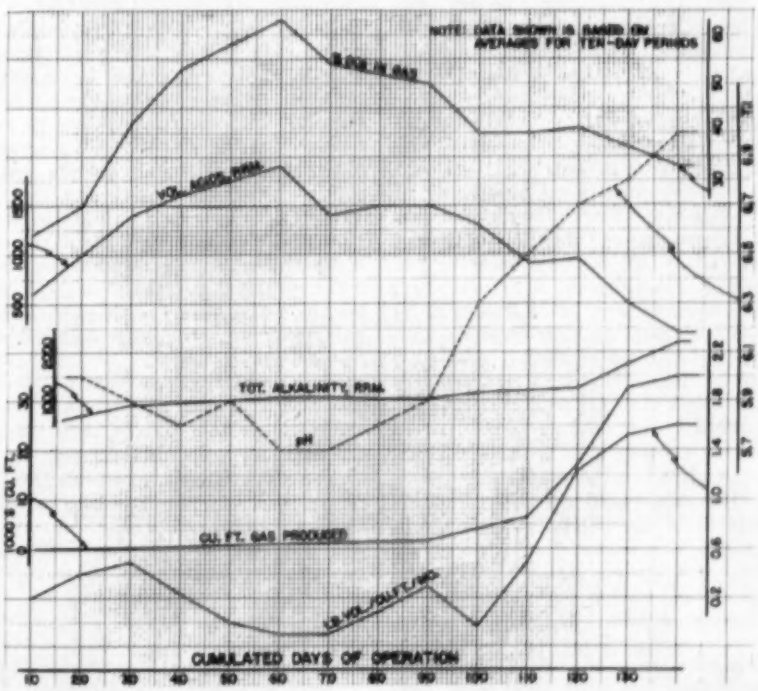

NOTE: DATA SHOWN IS BASED ON AVERAGES FOR TEN-DAY PERIODS
% CO2 IN GAS
VOL. ACIDS, PPM.
TOT. ALKALINITY, PPM.
pH
CU. FT. GAS PRODUCED
LB. VOL. ACIDS/C./MO.
CUMULATED DAYS OF OPERATION
10 20 30 40 50 60 70 80 90 100 110 120 130

FIG. 5—GAS production in digester No. 2 during first 130 days of re-start operation

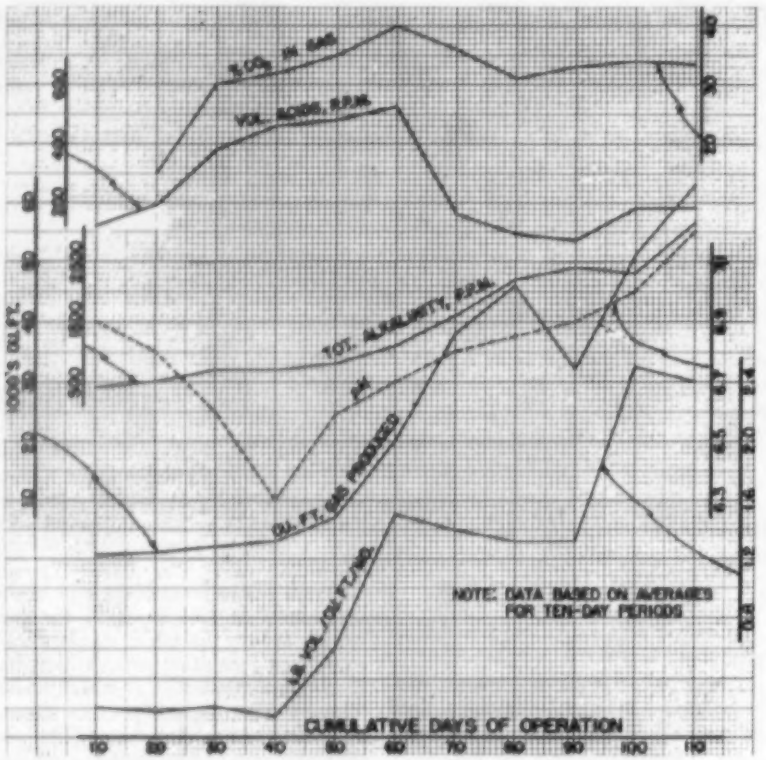

% CO_2 IN GAS
VOL. ACIDS, P.P.M.
TOT. ALKALINITY, P.P.M.
pH
CU. FT. GAS PRODUCED
LB. VOL. SOLIDS FED
NOTE: DATA BASED ON AVERAGES FOR TEN-DAY PERIODS
CUMULATIVE DAYS OF OPERATION
10 20 30 40 50 60 70 80 90 100 110

FIG. 6—GAS production in digester No. 1 during first 100 days of re-start operation

from the digestion system were returned to the plant raw sewage wet well.

On March 15, the digester was filled to the cover landing ledge with fresh raw sewage. By continuous heating and circulation for a period of four days, the tank temperature was brought up to 90°. This temperature was maintained throughout the new operation period.

The pre-determined initial rate of feed of raw solids to the digester was 0.30 pounds of volatile solids per cubic foot of digester capacity per month. The progress of fermentation development was to be followed by daily samples of tank contents analyzed for total alkalinity, pH, total solids, total volatile solids, volatile acids, and the CO_2 content of the gas produced. Gas volumes were reported for each 8-hour shift with the decimal point placed in the proper position.

The concentration of volatile acids was to be the determining factor in making any exceptions to the predetermined feeding rate of 0.01 pound of volatile solids per cubic foot of digester capacity per day. If, after several weeks operation, volatile acids for two successive days reached a maximum figure of 1800 ppm, feed of fresh solids would be discontinued for a day or two, or until a favorable drop in the acid content occurred. The extent of this drop should approximate 100 to 200 ppm. If resumption of feed of solids did not result in a corresponding jump of volatile acid, feeding was to be continued on a daily basis at the predetermined rate, or the feed was to be increased if the volatile acids showed a tendency to drop or remain constant.

Figure 5 shows the gradual changes which took place during the 130-day history of the start of proper fermentation in digestion tank No. 2. With the exception of one addition of 1500 gallons of digested sludge brought in by tank truck on the 40th day of operation, all feedings were of fresh raw sludge solids. The data are presented in periods of 10 days, using the average value for the graph.

The first definite favorable trend began on about the 92nd day of operation (June 14). At this time, volatile acids began to decline. Methane gas production increased and pH moved above 6.0. The CO_2 of the gas being produced dropped below 50 per cent and started a sharp downward trend.

Total alkalinity as a parameter of progress was rather slow to indicate the favorable changes taking place. However, a short time later, during the period of July 1 to 22, (the 109th to 130th day of operation time) the total alkalinity in the tank practically doubled, the change being from 1200 ppm to 2100 ppm. Increased feeding rates at this latter stage resulted in increased gas production and without an increase of volatile acids. The production of methane was now well established, with sufficient natural alkalinity present in the tank to absorb sizeable shock loads that might result during the normal course of operation.

Volatile Acid Determination

Needless to say, several hundred volatile acid tests were made while this particular digestion tank was in the development stage. As an aid to those wishing to utilize the volatile acid test as a means of control in digester operation, the following complete method for making the test is described.

The suggested method is somewhat empirical in nature. It is intended for determination of volatile acids in sludge undergoing anaerobic digestion, and is based on laboratory experience comprising several hundred tests.

Briefly, a quantity of sludge is filtered to produce sufficient filtrate for the test. The filtrate is acidified and an aliquot is distilled in a water-cooled distillation apparatus at atmospheric pressure. The distillate is collected and analyzed for total acidity by titration with standard alkali using phenolphthalein indicator.

Results are reported in ppm as acetic acid. Consistent recovery of 70 per cent theoretical is obtainable.

The apparatus and chemicals needed include:

25-cm filter paper, open texture, rapid filtering.

6-in. glass funnel to accommodate larger paper.

250-cc pyrex beakers.

250-cc graduated cylinder.

25-cc burette for titration.

5-cc measuring pipette graduated to 0.1 cc.

1000-cc distilling apparatus with Graham condenser, Pyrex-Corning No. 3360.

Stopcock lubricant for ground glass connections.

Pumice stone, several small pieces.

N/10 sodium hydroxide.

Concentrated sulfuric acid, A.C.S.

Phenolphthalein indicator.

Ring Bunsen burner, stand, and supports for distillation apparatus.

The procedure is as follows:

1. Filter about 500 cc of the sludge sample and collect approximately 75 cc of filtrate in a clean beaker. Discard the sludge residue in the funnel.

2. Rinse the distilling flask and condenser several times with distilled water. Pour 50 cc of filtrate from step 1 into the distillation flask.

3. Add three or four pieces of the ignited pumice stone to the flask to control "bumping" during distillation.

4. Add 150 cc of distilled water followed by 2.5 cc of concentrated sulfuric acid, making sure the acid contacts only the liquid in the flask when added.

5. Place stopper in top, assemble flask to condenser, using Dow Silicone lubricant or equivalent for ground glass joints.

6. Adjust the gas flame to give a distillation rate of 4 to 5 ml per minute. Maintaining this rate is important. The 150 cc of distillate should be collected in a period of 30 to 37 minutes. It is desirable to use a 250-cc graduated cylinder to collect the 150 cc of distillate. The rate should be checked at 5-minute intervals. If available, an interval alarm clock is advantageous.

7. Transfer the 150 cc distillate to a 250-cc beaker or Erlenmeyer flask, and titrate with N/10 NaOH to pink end-point using phenolphthalein as indicator.

8. Interpretation of results—When 50 cc of sample is used, as in step 2, the ml of NaOH x 171.6 = ppm volatile acid as acetic acid. For example, if the final titration required 13.8 cc of the N/10 NaOH to give the pink end-point, then 13.8 x 171.6 = 2368 ppm volatile acid.

9. Possible sources of error—

(a) Do not substitute another type of distilling apparatus for the one specified. Consistency of results will not be possible with other apparatus.

(b) Thorough cleaning of the flask and the side arm with distilled water will prevent possibility of direct transfer of acid to the condenser.

(c) Use exactly the same equipment and technique for each determination. Changing the size of the flask, the condenser, or the rate of distillation will give inconsistent results.

(d) When adding the concentrated sulfuric acid, be sure none of the acid touches the sides of the neck of the flask.

(e) If difficulty is encountered in obtaining a consistent distilling rate, the use of a protective shield will prevent drafts of cool air from causing irregular application of heat to the distillation flask.

(f) If the pumice stone is not used, the "bumping" during distillation may loosen or possibly break the flask and/or condenser.

No. 1 Re-Started

Further reference to Fig. 5, and particularly the first week in May (the 50th day of operation), indicates that progress at that time was not too encouraging. Therefore, plans were made to completely clean out the No. 1 digester, which had been on a program of low feed. Restarting of this tank was to be by use of seed sludge hauled in by tank truck from a neighboring city.

Accordingly, from May 18 to 25, a 1700-gallon tank truck was placed in service to haul digested sludge from Lebanon, Ohio, to the Little Miami sewage works, a distance of about 30 miles. Approximately 27,000 gallons of liquid seed sludge was pumped to the No. 1 digester tank. This digester had been thoroughly cleaned, refilled with sewage, and brought up to a temperature of 80°.

Desirable seed sludge was to be characterized by low volatile acid content (not over 300 ppm), a total alkalinity of 1800 ppm or higher, a pH of 7 or above, and total solids of 4 to 7 per cent. The seed sludge used met all of these qualifications.

Since the quantity of seed used was relatively small for starting a digester of 500,000-gallon capacity, additions of raw solids were carefully controlled to avoid development of an undesirable acid condition in the tank. The contents of the disgester were circulated for approximately 4 to 6 hours per day in order to maintain a mean temperature of 85°.

The progress of methane fermentation in digester No. 1 is depicted by the 100-day record shown in Fig. 6. The "break" in volatile acid concentration occurred on about the 62nd

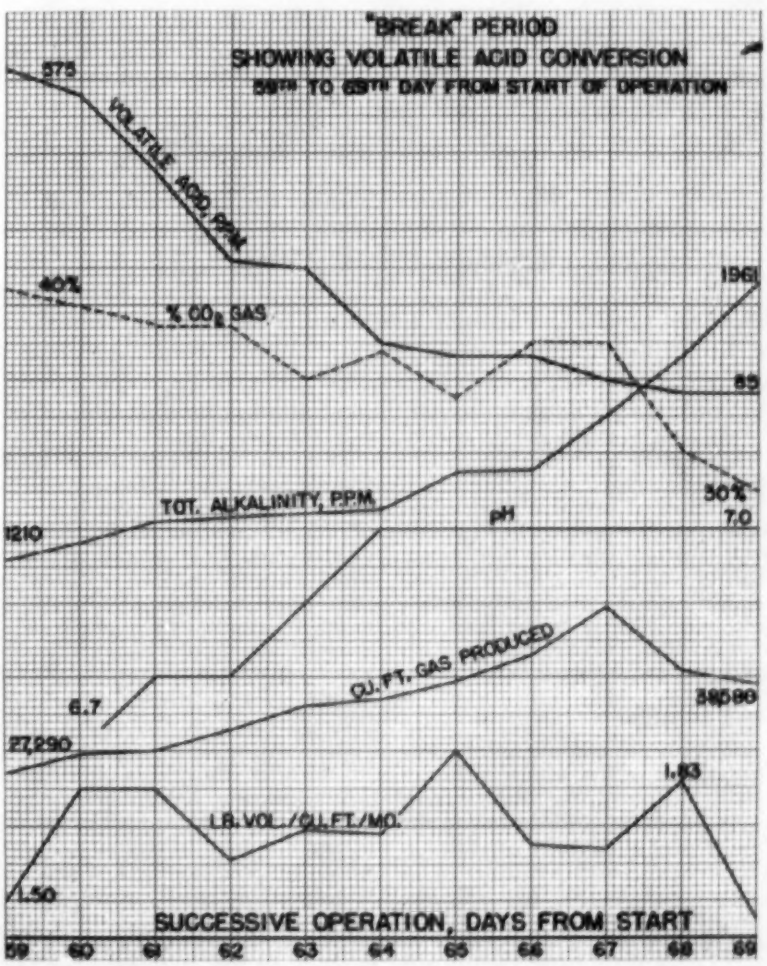


FIG. 7—BREAK PERIOD of Fig. 6; volatile acid conversion (59th to 69th day)

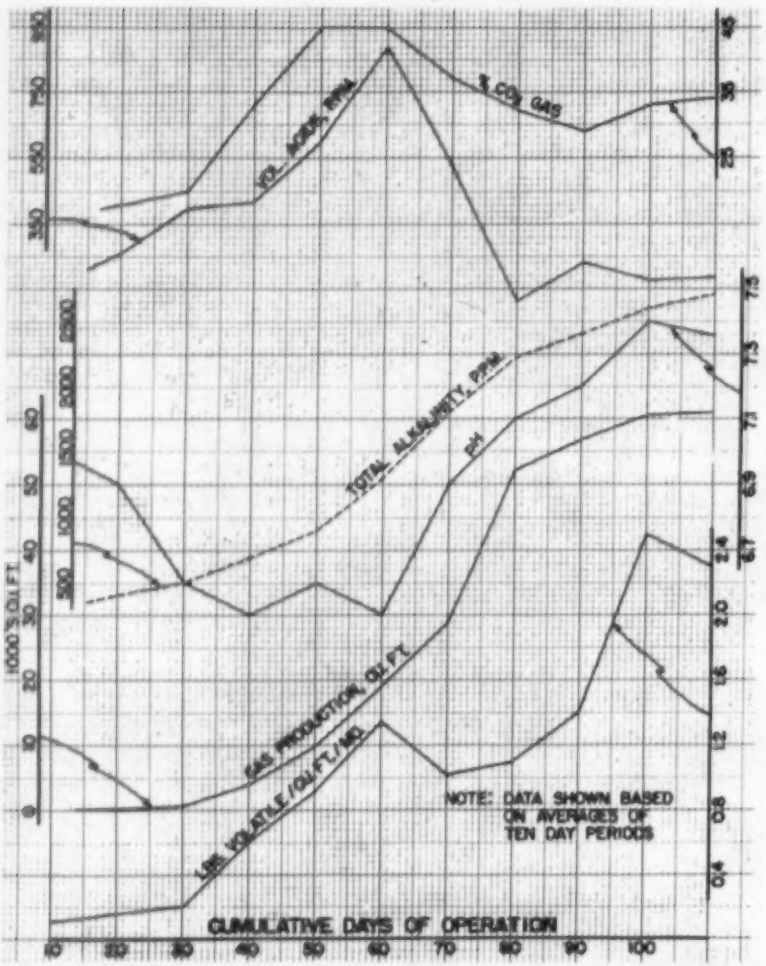

VOL. ACIDS, PPM.
% CO_2 GAS
TOTAL ALKALINITY, PPM.
pH
GAS PRODUCTION, CU. FT.
LBS. VOLATILE / CU. FT. / MO.
NOTE: DATA SHOWN BASED ON AVERAGES OF TEN DAY PERIODS
CUMULATIVE DAYS OF OPERATION

FIG. 8—GAS production in digester No. 3 during first 100 days of re-start operation

day of operation. Also, at this time, the CO_2 in the gas began to decrease, the pH went up to 7.0, and the reserve volatile matter in the tank was rapidly converted to gas.

This decisive period in the development cycle is expanded in Fig. 7 to more strongly emphasize the critical changes which took place. The total alkalinity doubled in concentration from the 54th day to the 72nd day of operation. The change was from 1,000 ppm to 2,000 ppm.

No. 3 Re-Started

On May 26, digester No. 3 was emptied and refilled with raw sewage to float the cover. The feed of fresh solids was again controlled as in the development of digesters No. 1 and 2. Volatile acid concentration reached a high of 950 ppm on the 58th day after the tank was started. Eight days later, the acid concentration was down to 275 ppm, the CO_2 in the gas had dropped from 45 per cent to 35 per cent, and the quantity of gas produced daily had increased from 22,000 to 34,000 cubic feet.

Two transfers of supernatant liquor from digester No. 1 were made to digester No. 3, one on the 15th day of operation, and one on the 34th day of operation. This material undoubtedly contained beneficial seed organisms which aided in establishing methane fermentation. Figure 8 summarizes the progress of digestion as shown by volatile acids, CO_2 of gas, quantity of gas, pH, and total alkalinity.

No. 4 Re-Started

With three active digesters in operation by July 24, and all producing normal quantities of gas, tank No. 4, which had been emptied and cleaned, was started by transfer of seed sludge from tanks No. 1, No. 2, and No. 3.

The development of digester No. 4 is shown by Fig. 9 so that a contrast may be drawn between the non-seeded No. 2 digester and the fully seeded tank No. 4. On a volume basis, about 55 per cent of the digestion tank holding capacity was from seeded sludge pumped in by transfer from the other three digesters.

Feeding of fresh solids was started immediately on July 27 at a rate of 1.4 pounds volatile solids per cubic foot digestion capacity per month. After 18 days the tank alkalinity was at 2000 ppm, with volatile acids below 150 ppm. Daily gas production was of the order of 40,000 cubic feet per day. This was equivalent to 9 cubic feet of gas (containing 31 per cent CO_2) per pound of raw volatile being added daily.

Return to Stage Operation

Nine months time had been required to successfully develop the digestion system to take the full solids load. On August 18, digesters No. 1 and No. 3 were once again designated as primary digesters for stage operation, with tanks No. 2 and No. 4 as their respective secondary units. The raw sludge was pumped to the primary digesters on an alternate 8-hour shift schedule, thus dividing the raw solids equally to these two tanks. During the next 20-day period each of the primary digesters produced about 60,000 cubic feet of gas per day. Volatile acids in the active tank liquor remained below 200 ppm.

Accelerated Loading Test

A plan was then outlined to determine, if possible, what the ultimate loading rate to one of the digesters might be when operated under carefully controlled conditions. Digester No. 1 was selected for this test operation, and the rate of feed of fresh solids to this tank was gradually increased. Control of the process was by volatile acid test.

Throughout the 14-day period from September 9 to 22, about 65 per cent of the plant raw sludge solids were added to digester No. 1. The remainder was pumped to digester No. 3.

An almost immediate increase in gas production was noted. The volatile acids in the active tank liquor remained in the range of 100 to 200 ppm. As there was no indication of overload from excessive raw solids at this stage, the feed rate was further increased until it was possible to put all the plant raw sludge in the No. 1 digester on a continuous daily schedule.

Figure 10 shows the operational control data for the 14-day period from September 26 to October 9. During this period the No. 1 digester was

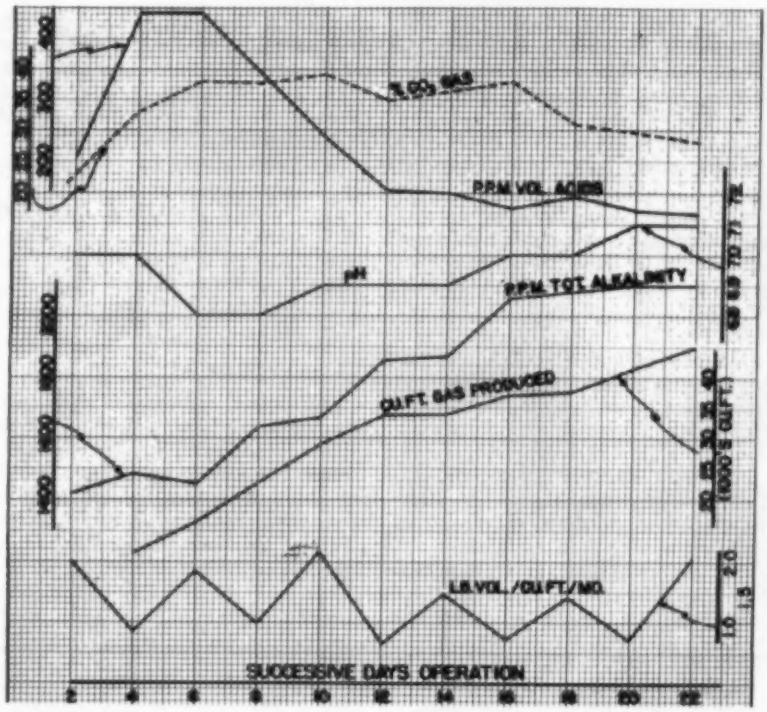


FIG. 9—GAS production in digester No. 4 during first 22 days of re-start operation

fed all of the raw sludge solids from the settling tanks. As indicated, the volatile solids loading rate was above 7.0 pounds per cubic foot of digester capacity per month. This is in contrast to the 0.30 pound of volatile solids fed when the No. 2 digester was first placed in operation under a controlled, limited feeding rate.

It is significant to note that there was no evidence of volatile acid increase throughout the course of the test period. Conversion of acid to gas seemed to proceed in perfect sequence and balance. The gas production rate was 2.0 cubic feet per cubic foot of digester capacity. At this rate the tank contents are literally boiling. There should be no top scum problem under these conditions.

It was unfortunate that it was not possible to continue the accelerated operation procedures because of limitations other than those pertaining to digestion.

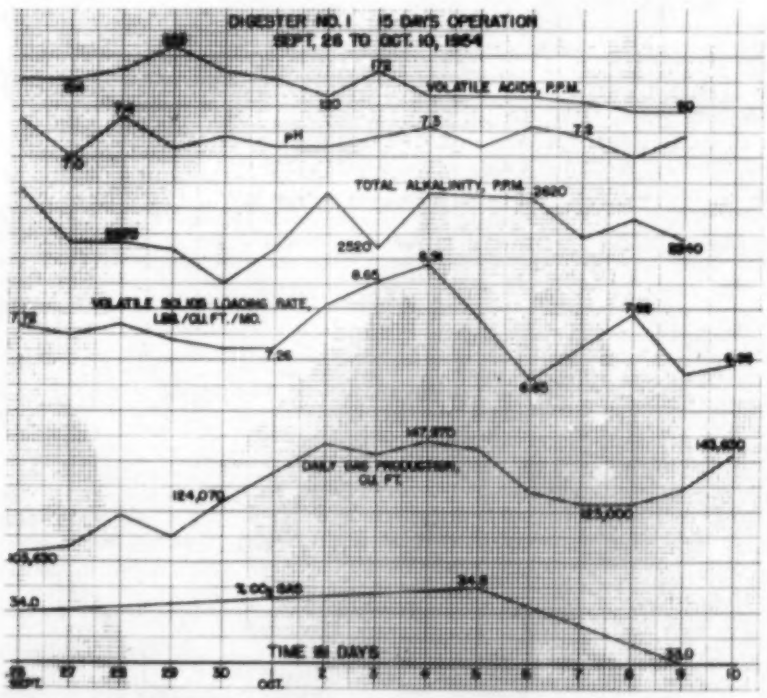


FIG. 10—ACCELERATED loading investigation, digester No. 1

Summary

In retrospect, the failure of the initial method of starting the sludge digesters at the Little Miami plant may be attributed to three major factors, as follows:

1. Failure to detect the build-up of volatile acids in the digestion system during the first 30 days of operation.
2. Misinterpretation of gas production volumes because of error in reading the gas meters.
3. Additions of raw sludge solids to the digesters far in excess of quantities desirable for starting an unseeded digester.

Conclusions

1. When new treatment plants are first placed in operation it may be advisable to by-pass part of the raw sewage for a period of 30 to 100 days while sludge digesters are developed under controlled reduced feed of fresh solids.
2. The volatile acid test is a reliable control tool and should be used when the digesters are first placed in operation as well as during the succeeding period of establishment of methane fermentation.
3. Volatile acids in concentrations above 1800 ppm are undesirable for development of normal digestion in starting new digesters.
4. Digesters "fouled" to the extent of 4000 ppm or more volatile acids should be emptied and started again under carefully controlled conditions. This was demonstrated by sludge samples (high in volatile acids), which were held in 55-gallon drums for a period of six months, and showed a very small decrease in volatile acid concentration — from 4581 ppm to 3713 ppm.
5. The CO_2 of the gas produced in new tanks must be as high as 65 per cent by volume during the development stages of digestion. Sharp re-

duction in CO_2 should follow once the volatile acids in the tank are converted to methane and CO_2.

6. Until a normal trend is established in a new digester, feed rates of raw fresh solids should be approximately 0.01 pound volatile solids per day (0.30 pound per month) per cubic foot of digestion capacity. This would be of the order of one-tenth the nominal design loading rate. The rate of feed following the initial feed of approximately one-tenth of the nominal design loading rate, may be increased by increment of not more than one-tenth of the nominal design loading rate if the volatile acid determinations for two successive days do not show a decided increase; or, if they show a decided decrease, until the full ultimate load is reached.

7. Total alkalinity in the tank liquor may be misleading as a parameter of digestion progress during start-up periods. High methyl orange alkalinity may accompany high volatile acids during the acid digestion phase when starting a new tank in operation.

8. The pH of the tank contents does not follow closely the day to day changes which occur in the initial stages of digestion.

9. Sewage gas containing in excess of 55 per cent CO_2 will not burn in a laboratory-type Bunsen burner or in waste gas burners. Satisfactory burning was possible at 53 per cent CO_2.

10. Sludge and tank liquors containing volatile acids above 3000 ppm are very odorous and undesirable to handle without special means for odor control.

11. Seed sludge, if used in sufficient quantity, may reduce the start-up period to as short a time as 18 days or less.

12. Without seed sludge digestion may be established in a new or clean tank within 60 to 100 days if proper feed control measures are observed.

13. The following are desirable characteristics of a well-established sludge digester:

(a) Total alkalinity of 2000 or more ppm.
(b) Volatile acids less than 300 ppm.
(c) pH of 7.0 or above.
(d) Production of gas containing less than 36 per cent CO_2 by volume.

Acknowledgments

The author wishes to acknowledge and thank Assistant Superintendents Arthur E. Schwer, Jr., and Sam W. Shafer for their assistance in reviewing the written text and in preparation of the graphs, and Herbert Broge, Chemist, for his outline of the volatile acid test procedure.

FSIWA Technical Program

28th Annual Meeting, Atlantic City, New Jersey, October 10-13, 1955

THE GENERAL PROGRAM for the 28th Annual Meeting of the Federation of Sewage and Industrial Wastes Associations, to be held in Atlantic City, N. J., October 10-13, 1955, in conjunction with the New Jersey Sewage and Industrial Wastes Association, has just been released as follows:

Monday, October 10

Morning

The Authority Approach to Stream Pollution Control.....*Robert S. Shaw*

Afternoon

Westchester County Solves Its Sewerage Problem.....*Guy E. Griffin and James Brown*
Additions to Buffalo Sludge Disposal Facilities.....*Frederick W. Crame, George F. Fynn and Charles R. Velzy*
Sewage Sludge Filtration Characteristics.....*B. A. Schepman*
Design and Operation of the Wilmington (Del.) Sewerage System.....*Roy H. Ritter*

Tuesday, October 11

Morning

Natural Sediment in Stream Pollution Control.....*Richard D. Hoak*
High Rate Trickling Filters in Germany.....*Adolf Rumpf*
Acid Mine Drainage Problems.....*W. L. Patrick*

Afternoon

Federal Water Pollution Control Legislation.....*Mark D. Hollis*
Treatment of Complex Wastes From Appliance Park.....*K. S. Watson and C. M. Fair*
Sewer Maintenance in Los Angeles.....*Alvin Appel*

Wednesday, October 12

Morning

The Use of Radioactive Isotopes in Determining Flow Patterns in Lagoons.....*W. C. Seaman*
Operating Results on Paper Mill Waste Treatment Plants.....*Harry W. Gehm*
Petrochemical Waste Treatment Problems.....*Edward B. Showell*
Processing of Phosphorus Industry Wastes.....*John Horton*

Afternoon

Symposium on Fringe-Area Sanitation.....*John E. Kiker, Jr., I. Russell Riker, John W. Wakefield and Myron K. Nelson*
Thru-way Sewage Treatment Plants.....*G. Gale Dixon*

Thursday, October 13

Morning—Concurrent Forum Sessions

SEWAGE WORKS Operation.....*T. C. Schaetzle, Leader*
INDUSTRIAL WASTES Problems.....*James M. Brown, Leader*

Afternoon

Biological Purification of Citrus Waste.....*James B. Lackey*
Oxidation of Aromatic Compounds by Activated Sludge.....*Ross E. McKinney*
Fundamental Study of Activated Sludge Building.....*Eugene Weisberg and H. Heukelekian*
Sewage and Industrial Waste Research—Open Discussion

The Measurement of Flowing Water

A brief description of the more important basic devices for accomplishing this important task through the ages

by CHARLES G. RICHARDSON

Mr. Richardson is Vice-President of Builders-Providence, Inc., Providence, R. I. This article is not presented as discussing entirely new material, but attempts to assemble the information, for the first time, in approximate historical sequence.

A 1953 ARTICLE in German, entitled "Hundert Jahre Wassermessung," by engineer Martin Schaack of Karlsruhe, describes in much detail the early attempts to measure water. Of interest here are the following paragraphs:

"If one will take an extensive view of the progress of the technique of water meters, one will not overlook antiquity.

"A water meter which has been in operation for 3,000 years, in the Oases Gadames in North Africa, divides into equal parts the quantity of water served from the spring to the inhabitants of the farms. The procedure is as follows: A man pulls a pot of water on a cord from the spring-ground. The pot has a hole, from which the water runs out again, a procedure which lasts three minutes. Each land proprietor gets water from the spring until the number of full pots is reached that the water commission allows him. The man at the spring knows the irrigation program and when the turn for the next land proprietor comes, he throws a piece of straw in the drain. When the piece of straw arrives at the piece of land which, by now, should be irrigated, the owner opens a sluice gate that lets the water flow to his field and stops by means of another sluice gate the flow to the before irrigated plot of land. In this way a fair division is given to all.

"Exhaustive research on the jurisdiction of ancient water supplies has given us a composite picture of this technique, before which we stand in admiration.

"Babylon, a two-stream land, was the first of the ancient granaries that had an irrigation program. The water of the Euphrates and the Tigris lead alternately from one stream to the other; that is, the water flowed in a standard difference, one time from the Tigris to the Euphrates and another time from the Euphrates to the Tigris, over and over again. It is not out of the question that the Tower of Babel, besides its well-known meaning as a temple, was also a signal station from which this water distribution was assessed. It was a technique which, in today's regulation of water supply of the Ruhr, and in Holland, has a very similar parallel.

"Chinese and Egyptian well builders have produced significant results (wells up to 500 meters deep). The English were astonished, after having conquered the Indians, to find power catchments of 80 million cubic meters capacity; dam length, 20 kilometers; dam height 6 meters; which compare favorably with dams of today. These arrangements were made, of course, without today's technical knowledge.

"The water line from Mt. Hagis Georgios through two valleys to the Castle Pergamon evidently was made of bronze, a costly material. This also appears to be the reason why not a single piece of this pipe has been found. Only the stones that served to anchor the ends of the pipe lines remain.

"The question of water measurement in its present form became acute when, for about a hundred years, larger water works were being built in England to take care of increasing consumption. The first water meter was a reaction-turbine counter with a cast-iron housing lined with bronze and other non-ferrous metals. From 1852 on this type was supplied in great quantities and was serviceable for the situation at that time.

"A decided step forward was made when, in 1865, the principle was reformed and, instead of the reaction-turbine, an action-turbine with a more durable runner was used. With this, the 'wing-wheel counter' of today was created in its basic form.

"It lasted for a long time, until man had learned the cause of erosion. Friedrich Lux discovered a new means, more through intuition than pure knowledge, in which he set the greatest part of the metal of the measuring works of his counter in hard rubber."

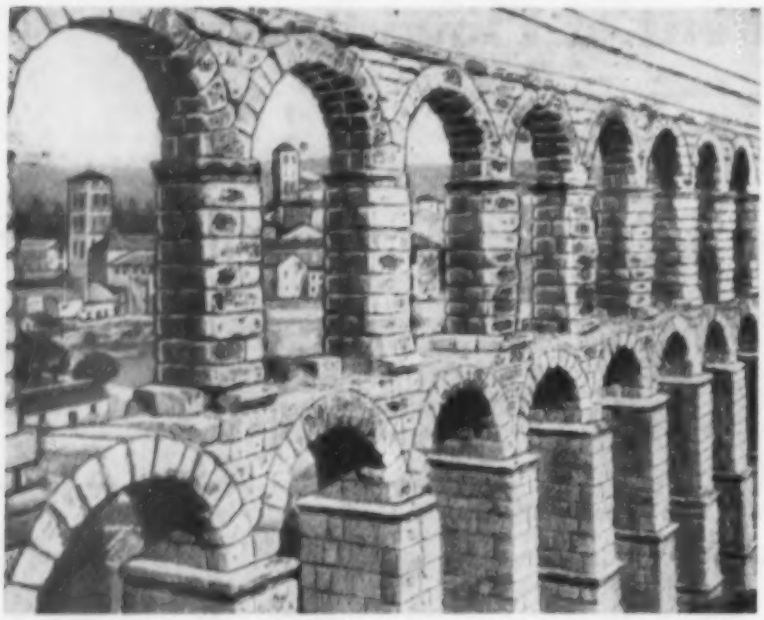
Roman Adjutages

For nearly half a century, until 313 B.C., the citizens of Rome were content to draw their water supply from the Tiber River, wells and springs. As in our own times, such sources became entirely inadequate to meet the needs of a rapidly growing city and the first of the great aqueducts, the Appian, was constructed. This was followed, forty years later, by the Anio Vetus and, during the next three centuries, by seven others.

All of them are described in meticulous detail by Water Commissioner Frontinus in his two books (now a collector's item) of "De Aquis Urbis Romae" (translated into English by Clemens Herschel under the title "The Water Supply of the City of Rome").

One cannot pass by Frontinus with the mere mention of his name. The office of Water Commissioner (approximately 35 to 104 A.D.) was, from olden time, filled by the most distinguished citizens. Frontinus set an example for all future water commissioners to follow, in honest devotion to duty, thoroughness of accomplishment, and sterling character. His voluminous report can be read with profit and astonishment over the progress made during those ancient times in the development of metal pipe, pipe fittings, plug cocks, inverted siphons, ornate fountains and baths, and possibly in methods of measurement and filtration. Herschel interestingly comments:

"It must be remembered that we are speaking of the works of a very practical people. They were engineers by nature, rather than architects or men of science only; they taught the useful from choice, rather than that which was merely beautiful in design



ANCIENT Roman aqueduct brought water for famous baths, fountains and other uses

or tendency. They felt comparatively little predilection for 'pursuing science for science's sake,' as the phrase goes, while they pursued to the utmost of their abilities, and most ably for their day, that 'art of directing the great sources of power in nature, for the use and convenience of man,' which constitutes the profession of the civil engineer."

After describing in great detail the construction of the nine huge aqueducts, Frontinus wrote:

"Having now given the builders and the age of each aqueduct, also their sources, lengths of channel, and order of heights, it seems to me not out of keeping to go more into detail, and to demonstrate how large is the quantity of water which is allotted to public and to private uses, as well as for luxury; and through how many tanks it is conveyed, and in what wards these are located; *how much water* is distributed within the city walls, how much without, how much is used for water basins, how much for fountains, how much for public structures, how much on account of the State, how much by private consumers. But before I mention the names *quinaria, centenaria,* and those of the other adjutages by which water is gauged, I deem it expedient to state what is their origin, what their discharge, capacity, or value, and what each name means; and to show, after presenting the rules according to which their proportions and capacity are computed, how I discovered their discrepancies, and the way I set about to correct them.

"The adjutages to measure water are arranged either according to digits or inches. Digits are used down to the present day in Campania, and in very many places in Italy; inches in Apulia and elsewhere. The digit, according to common agreement, is the one sixteenth part of a foot, the inch the twelfth; but even as there is a difference between the inch and the digit, so also digits differ among themselves; some are called square, others round. The square digit is greater than the round digit by three fourteenths of itself; the round digit is smaller than the square digit by three elevenths, obviously because the corners are lopped off."

Just a few paragraphs further, we find the amazing statement:

"But every adjutage is gauged either by its diameter or circumference, or by its area of clear cross-section; from any of which its capacity may be found."

It seems natural that we turn to Herschel for pointed comment. He writes:

"Let us see what ideas were extant on hydraulics in Frontinus' time. The most troublesome point of ignorance he had to contend with was a total inability to measure the velocity of water, or even to rightly and fully grasp the idea of such velocity, whether as flowing in an open channel or in closed pipes. He accordingly compares streams of water merely by the areas of their cross-sections. A square foot of water is all one to him, whether it be one of the eight square feet of cross-sectional area of a stream in a conduit, or whether it be composed of the sum of two hundred or more cross-sectional areas of lead pipes leading out of delivery tanks to fountains, or to water basins, or to private consumers, and ending and discharging at as many different elevations. To the expert of today, this seems excessively silly; and yet the same thing is constantly being done even now by those who ought to know better. The average man today will talk about 'a stream of water that will fill a six inch pipe,' a perfect parallel to the *quinaria* (0.907 English inches) of Frontinus; and there are hundreds of deeds on record conveying 'square feet of water' for power purposes, just as though the law of falling bodies and its application to hydraulics had never been discovered; and unmindful of the fact, as one old Italian writer on water-rights has expressed it, that to speak of a stream of water by its area of cross-section is like estimating the volume of a cylinder merely from the area of its base."

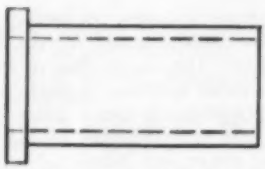
Yet there is at least some evidence, as we read Frontinus, that he was frequently troubled over his adoption of pipe area as the sole measure of volume discharge for he wrote, at one point in his history:

"Let us not forget in this connection that every stream of water whenever it comes from a higher point and flows into a delivery tank through a short length of pipe, not only comes up to its measure, but yields, moreover, a surplus; but whenever it comes from a low point, that is, under a less head, and is conducted a tolerably long distance, it will actually shrink in measure by the resistance of its own conduit; so that on these accounts, either an aid or a check is needed for the discharge."

In other words, a check of some sort was required *to make the pipe discharge the quantity normal for its size.* In another place, he writes:

"Whence it appears that the amount measured by me is none too large; the explanation of this is that the more impetuous stream of water increases the supply, since it comes from a large and rapidly flowing river."

Herschel comments:



ROMAN adjutage was simple bronze orifice of specific size

"And then he goes on again, worrying himself into all sorts of explanations why his gaugings by areas, made irrespective of heads and velocities, do not balance. The frauds of the water-men, of the plumbers, and of others who draw water unlawfully, always furnish a handy explanation, however."

Our perplexity increases when we realize that Hero, of Alexandria, thought by some to be the teacher of Frontinus, already had announced:

"Observe always that it does not suffice to determine the section of flow, to know the quantity of water furnished by the spring. This we said was twelve square digits. It is necessary to find the velocity of its current, because the more rapid the flow, the more water the spring will furnish, and the slower it is, the less it will produce. For this reason, after having dug a reservoir under the stream, examine by means of a sundial how much water flows into it in an hour, and from that deduce the quantity of water furnished in a day. Thus one has no need to measure the section of the stream."

Notwithstanding the false premise of Frontinus, here indeed was the beginning of the art of measuring flowing water, which will be emphasized as we pass on to further developments in Roman practice.

Quoting Herschel:

"But some control of the amount drawn had to exist, and we accordingly find that the measure of a grant in the City of Rome, A.D. 97, was the right to insert, at a designated place in the public delivery tanks, or cisterns, which received their supply, either directly or through lead pipes, from the public aqueducts, a circular, bronze adjutage, or short piece of pipe, stamped by the public authority, not less than about nine inches long and of a designated diameter; some fifteen such diameters being in ordinary use; and to allow water naturally to flow through this adjutage; it being the law, moreover, to ensure a natural flow through the stamped bronze adjutage, that the lead or other pipe immediately downstream from it should have the same diameter as the adjutage, on a length of not less than fifty feet, measuring from the downstream end of the adjutage."

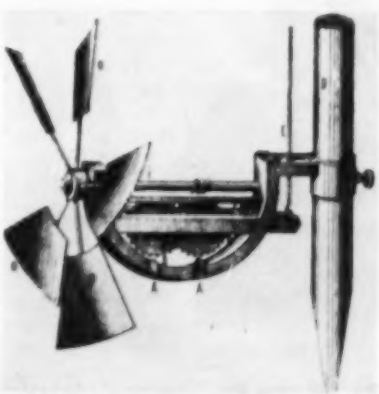
Frontinus definitely realized that there were other factors which limited the quantity of water which could be drawn. He says:

"An adjutage placed at right angles and level, it maintains its proper measure; set against the current of the water and sloping down, it will consume more; set sloping to one side, so that the water flows by, and inclined with the current, that is, placed less favorably for swallowing water, it will receive the water slowly, and in a scant quantity.

"It must also be left optional to attach any kind of lead pipe to the adjutages; but there must rather be attached for a length of fifty feet one of the same interior area as that which the adjutage has been certified to have, as has been ordained by a vote of the Senate that 'no one to whom a right to draw water from the public conduits has been granted shall have the right to use a larger pipe than a *quinaria* for a space of fifty feet from the delivery tank out of which he is to draw the water'."

The water commissioner calls attention to frauds which were being practiced by attaching pipes of larger diameter to the adjutages and, as a consequence, the water was not, he says, "held together for the lawful distance."

The Naples Museum exhibits three small bronze pipes which are believed to be genuine adjutages, 9 inches long and 0.72 inches in diameter. It was required that:



ORIGINAL form of Woltman meter

PITOT tube measures difference between static and flowing head

(a) The adjutage must be entered at a designated point.

(b) Water rights limited the quantity of water to be drawn and ended with the death of the grantee.

(c) The setting of the orifices to be determined by the authorities.

(d) Adjutages must be of a prescribed form, dimension and material (bronze), and must bear the official stamp of the authorities.

Frontinus reports "cheating practices" discovered, in addition to the larger outlet pipes mentioned, as follows:

"To some pipes no adjutages were attached. Such pipes are called uncontrolled, and are expanded or contracted as pleases the water-men.

"When a water right is transferred to a new owner they will insert a new adjutage in the delivery tank; the old one they leave in the tank and draw water from it, which they sell."

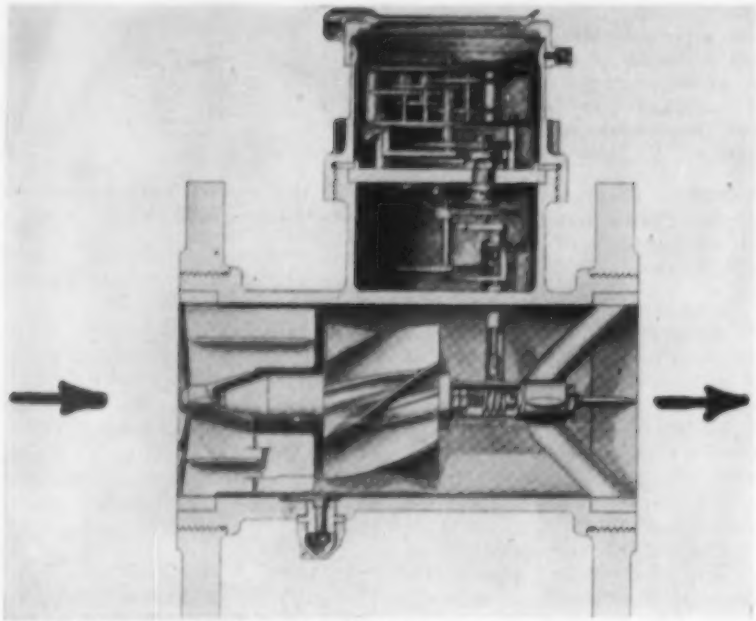
He adds, significantly: "Most especially, therefore, as I believe, should the commissioner have in mind to stop this."

Pitot Tube

In 1730, Henri Pitot (1695-1771), distinguished French engineer, was using a vertical glass tube with a short 90° tip at the lower end pointing upstream, in the River Seine, to determine whether there was a relation between the rise of water in the tube and the velocity of flow. Two years later, Pitot contributed a paper to L'Academie Royale des Seines describing his experiments and his tube, which he had combined with a second, static head vertical tube.

It is significant that he discovered the height to which the water rose in his tube was proportional to the square of the stream velocity as, in that very year, John Bernouilli had published the fundamental relation of head to velocity squared of water flowing through pipes.

Important modifications were made in the Pitot tube 125 years later by Darcy, another French engineer, improving the accuracy of the static



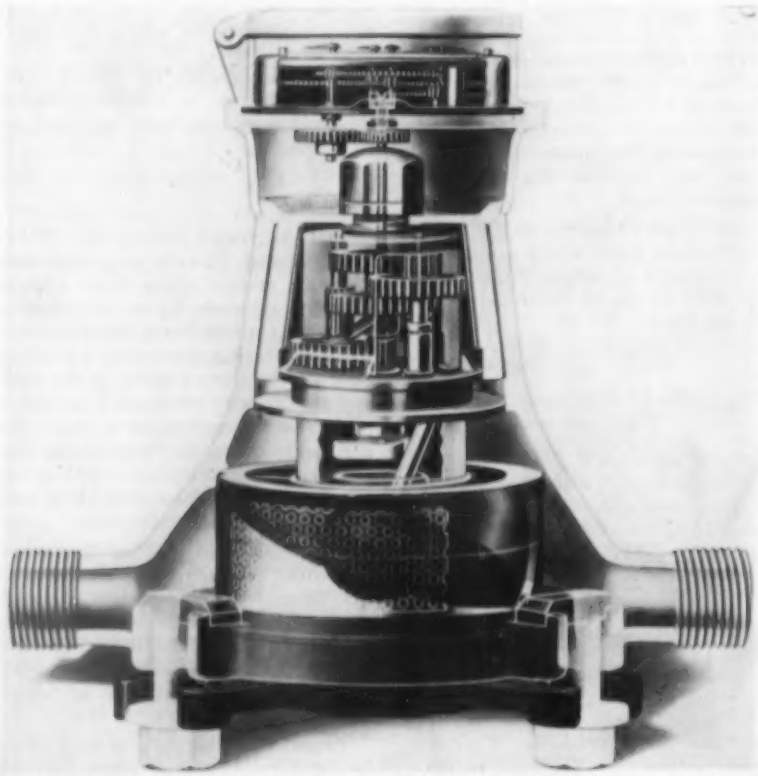
WOLTMAN-type meter for use in closed pipes

head readings and reducing the oscillations of the water columns.

Hiram F. Mills, of Boston, was the first American engineer to use the Pitot tube (1875); John R. Freeman applied it to the measurement of fire-stream jets.

Many additional improvements in design have followed, including photographic reproduction of the head deflections. The device has proved a very valuable instrument, particularly in investigations to locate water wastage in the underground piping systems of towns and cities.

An informative paper entitled "Pitot Tube Practice," by Edward S. Cole, President of the Pitometer Company, prominent developers of this device, was published in *A.S.M.E. Transactions* for August, 1935.



MODERN nutating disc meter, showing sand ring, gear train, etc. (Courtesy of Neptune Meter Co.)

Current Meters

There was published in Hamburg, in 1790, by Benjamin Gottlob Hoffman, a booklet describing a form of current meter, invented by Reinhard Woltman, for measuring flowing air and water. This seems to be the first practical meter for the purpose. It has since been materially changed in design and construction.

In general, it consisted of a very light water wheel, operated by the current, and carrying on its axis a worm for actuating wheels and a totalizer. The rate of flow was computed from the rotation during a given time period. Drawings show various forms of construction of the mechanism. Each size of meter had to be individually calibrated before use. The Woltman meter was illustrated and described in a German handbook, "Die Hydraulik," by G. Meilzner, published in Jena in 1878. At the time, it was not generally accepted that the Woltman meter could be used in a closed pipe.

A 1954 article on "Displacement Meters" *(Water Works Engineering)* stated:

"The history of use of water meters in the United States is practically covered by the past hundred years. It is reported that the first patent for a water meter was granted to William Sewell of Williamsburg, N. Y., on February 5, 1850.

"The earlier meters were displacement meters of the piston type and it is claimed that the first displacement meter was built in 1855 by the Worthington Pump Company, which used a piston plunger for measuring the water.

"The production of water meters increased but slowly, and it was not until about 1869 that the construction of water meters on a commercial basis was commenced in the United States."

The first water meter was designed in England by a Mr. Siemens working with a Mr. Adams, in 1850. This was the reaction-turbine type, which

Siemens obtained permission to manufacture in Germany. The firm of Siemens & Halske began manufacture about 1865.

Although such meters were made and appeared to give fairly accurate results, the hydraulic laws governing their action were never fully determined and the designs were therefore empirical.

Considerable trouble was experienced due to corrosion, as the meter casings were of cast iron and the internal working parts of bronze.

It was Herr Fred. Lux who first employed vulcanite for the meter mechanism. However, a good deal of difficulty was experienced at first, due to expansion of the material and to the quite unnecessary fear that the water would be contaminated by the sulfur used in vulcanization.

Improvements in vulcanite gradually were made and the material was accepted as being satisfactory in resisting corrosion.

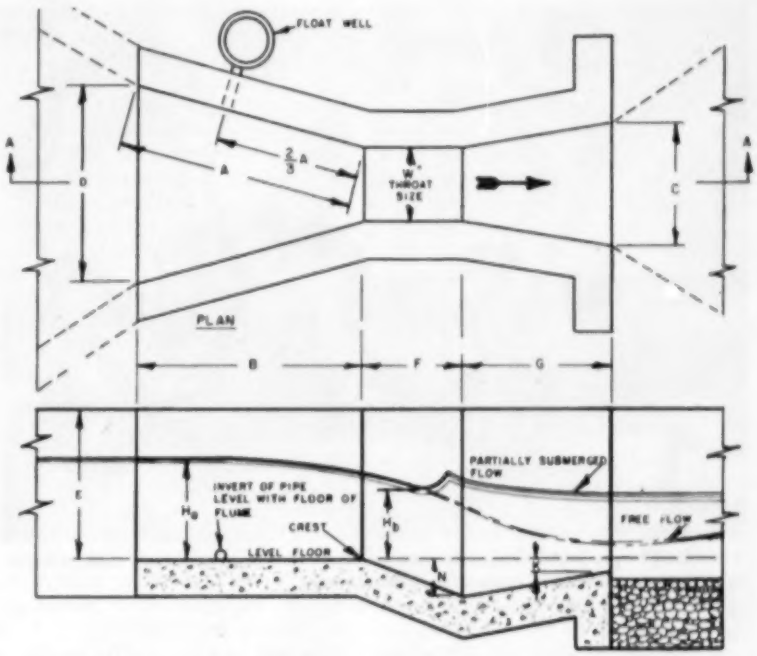
All water meters for many years were made with vertical rotor spindles, which naturally necessitated the "bending" of flow lines through a double right angle. It was Woltman who designed a meter with a horizontal axle affording a through flow.

But the subject of water flow measurement, from an historical point of view, is an extremely lengthy one. It is an extra-ordinary fact that in our patent archives there were a larger number of patentable inventions for mechanisms for measuring water taken out between, say, 1870 and 1900, than for any other purpose. Most—in fact, all save one here and there—died a natural death.

The sequence of progress was roughly as follows:

1. The rotary reaction turbine type.
2. The rotary fan type with multi-jet inner casing.
3. The reciprocating packed-piston volume types (Kennedy, Frost, Kent).
4. The rotary semi-positive meter, such as the cylindrical displacer, the elliptical displacer and the nutating disc type (such as the Empire, Kent Uniform, Trident, Badger, and others).

In this country, W. & L. E. Gurley are the prominent makers of the "Gurley Current Meter, Price Pattern" (W. G. Price, U. S. Geological Survey), which is similar in principle to the Woltman but much different in design, using a revolving series of cups instead of vanes. A 1910 A.S.M.E. paper, entitled "River Discharge," refers to the earliest type of current meter as being practicable only for measuring surface velocity, but commenting: "About 1790, Woltman modified this wheel so that it could be used beneath the surface."



SCHEMATIC diagram of Parshall flume, used for open flow measurement

The Parshall Flume

The ever-increasing need for larger volumes of water in the arid areas of the West presented, among many others, the following three major problems:

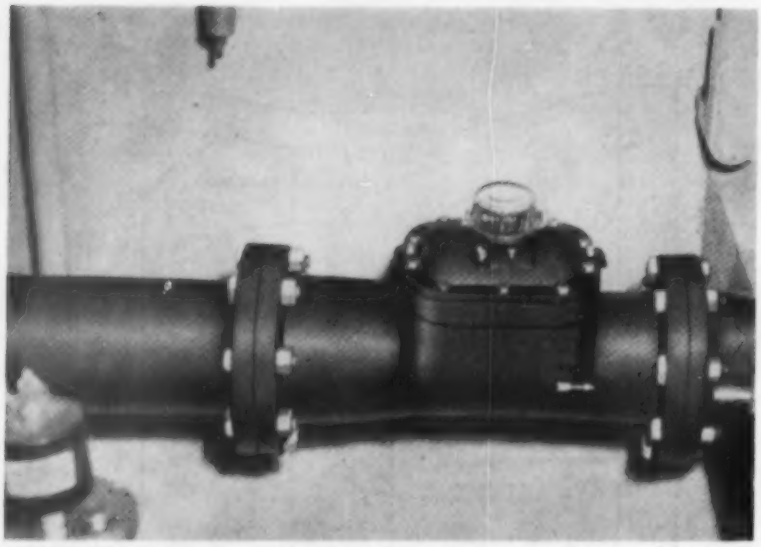
1. The building of great dams and reservoirs.
2. Fair daily distribution of the water to each farmer.
3. The supplying of relatively low cost meters to measure the water.

To problem No. 3, R. L. Parshall, irrigation engineer for the U. S. Department of Commerce, Division of Irrigation and Water Conservation, devoted years of study and experiment. As an early step, it was natural to adopt a standard weir. For irrigation ditches and canals this proved unsuitable, because the weir often cannot be used as a freely flowing measuring device owing to the flat grade of the channel, also to the gradual filling of the preceding "pond" with sand, sediment and debris, reducing the accuracy of measurement.

To overcome this, Mr. Parshall first devised a "Venturi flume" of wood with vertical sides and a flat bottom. This overcame the accumulation of sand and debris by greatly increasing the velocity of flow, but it was not entirely successful. Laboratory model tests were required for each size and it was necessary to compute the rate of flow by taking measurements of two hydraulic heads: the depth of water immediately upstream from the entrance to the conveying or "throat" section, and the minimum depth at the throat. By depressing and shaping the invert of the throat section like a wide open V, he found that only one measurement of head, upstream, was required up to about 70 per cent "submergence" (ratio of throat head to inlet head).

Thousands of calibrations established a formula and a correction for greater submergence values. Data for constructing this type of flume for throat widths from 3 inches to 8 feet, and tables giving the relation between inlet heads and cubic feet per second flow, were prepared by him and issued in 1950 as "Circular No. 843" by the U. S. Department of Agriculture.

The device, named the "Parshall flume" in his honor, is now widely used in the irrigation field and, to a considerable extent, in sewage treatment plants, where incoming raw sewage is measured in large open flumes and the actual rate of flow is transmitted to a distant instrument.



PROPELLER-type meter is used to measure water flow in larger pipes, such as industrial services, with heavy flows or wide fluctuations

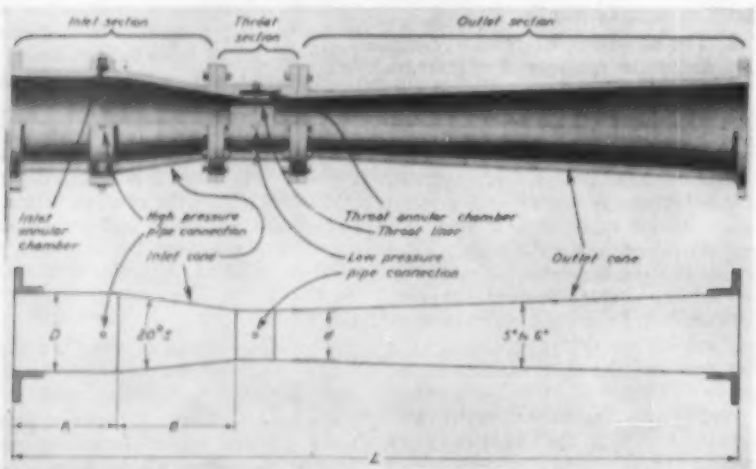
Orifice Meters

The so-called orifice meter is said to be one of the oldest devices for measuring or regulating the flow of fluids, dating back to the Romans of Caesar's time. Development of the thin plate orifice, the most commonly employed type, did not begin, however, until the early days of the present century, and still continues.

The determination of the relation between flow rates and differential pressures for various designs, loss of head occasioned by the device installed in the pipe line, etc., has been dependably established for various designs, and such data are quite readily available. Quoting from the A.S.M.E. publication on "Fluid Meters," 4th edition, the following statements are made as characteristic of standard concentric thin plate orifices:

"The pressure of the fluid drops abruptly as it flows through the orifice and, on the outlet side, the pressure continues to decrease slightly. The minimum value is reached at a short distance from the outlet side of the orifice. Beyond this minimum point, the pressure increases again slowly at first then rapidly for a short distance, then again more slowly until its second maximum is reached several pipe diameters beyond the orifice plate. Since no guiding of the stream occurs on either the inlet or the outlet side of an orifice, the acceleration and deceleration of the fluid stream, which the pressure gradient manifests, is accompanied by considerable turbulence and consequent dissipation of energy (pressure), especially on the outlet side. Consequently, for the same diameter ratio, the downstream maximum pressure is much lower for an orifice than it is for a flow nozzle. In other words, the percentage of differential pressure recovered with an orifice is slightly less than with a nozzle and much less than with a Venturi."

Orifice plates are largely employed in industrial plant pipe lines, especially for the measurement of water and oils: municipally, for the measurement of gas.



VENTURI meter has no moving parts in liquid flow, depending on differential pressures created between full and restricted pipe sections

The "Domestic" Meter

Inasmuch as the design and operative principle of the leading types of so-called domestic meters can be readily obtained from manufacturers' catalogs, they are not discussed here. Occasionally, political opposition has defeated the adoption of meters for measuring water supplied to dwellings and factories and little progress was made until the early 1880's. Wastage of water has been greatly curtailed by the adoption of domestic meters, varying in pipe size from ⅝ inch to 6 inches (for industrial plants).

Much difficulty was early experienced in the use of such meters due to the difference in the coefficient of expansion of the different metals employed in certain elements of the meters until Herr Fred. Lux successfully substituted Vulcanite at the troublesome points.

An informative and interesting article on the above subject, entitled "Metering — Displacement Meters," appeared in the February, 1954, issue of *Water Works Engineering*.

Propeller Meters

The propeller type of mechanical meter is relatively modern, designed for pipes and conduits much larger than standard "domestic" meters. Usually the complete meter forms a section of the pipe or conduit line and the propeller element is driven directly by the flowing water.

Care must be exercised to make certain that the stream approaches the propeller without agitation. This usually requires the insertion of a straightening vane unit preceding the propeller.

Transmission of the velocity is is made by direct or electric connec-

tion to a distant "counter," or totalizer, to determine the volume of the water flow, which is read directly in gallons or cubic feet.

Salt Velocity Method

The unique salt velocity method is largely credited to the late Charles M. Allen, of Worcester Polytechnic Institute. His associate, Leslie J. Hooper, transmits the following interesting information:

"Most of my knowledge of the history of the salt velocity method is based upon what Professor Allen commented on at various times in conversations. He became interested in the measurement of flow as a means of arriving at better efficiency test measurements for water wheels.

"He had worked with current meters and found them not too reliable, particularly when conditions became a little rough. He did play with a salt solution method which was written up in great detail by B. F. Groat and applied on several tests by the Aluminum Company of America.

"For accurate results, a great deal of care was necessary, coupled with a very expensive test program. It was in thinking over this method that it occurred to him to inject a small quantity of salt solution and try to measure the concentration of salt solution by means of an electrolytic cell, since this would avoid the painstaking and careful work required for chemical titration of samples.

"Because of temperature effects, and possibly other effects that were not appreciated, it was not found easy to measure the salt concentration electrically. Then it occurred to Professor Allen to inject small quantities of salt solution and to time the passage of that salt down the penstock at various electrodes.

"As far as I know, the first actual test that was ever made in this direction by Professor Allen was in 1920 when he lowered a bag of salt tied to the end of a pole into the entrance of our 40-inch steel pipe, broke the bag by a jerking motion of the pole and timed from this instant to when an ammeter needle showed the maximum deflection at some point near the water wheel at the laboratory.

"At this same time, he also played with color injected in the pipe and timed its passage similarly. He concluded that the salt was much more accurate than the color, due to the more refined methods of determining its presence. From then on he conducted a methodical test analysis of the factors contributing to the accuracy of the method."

The results of all these early tests are presented in a paper entitled "The Salt Velocity Method of Water Measurement," by C. M. Allen and E. A. Taylor, *(A. S. M. E. Trans.,* 1923).

The Venturi Meter

A major contribution to the measurement of flowing water was the invention of the Venturi meter by Clemens Herschel in 1887. This achievement is fully described and illustrated in *Water & Sewage Works* for September, 1937, entitled "The 50th Year of a Great Invention."

As its original principles and design had developed, it was found that, for the first time, a simple primary unit having no moving parts, for direct installation in pipe lines without limit to size, had thus become available. With small variation in calculable coefficient for a wide range of diameters, Venturi meters are now in service in pipe lines from ½ inch to over 10 feet in diameter. The general proportions of design have been little altered since those determined by the inventor in his original calibrations.

The "primary" units, such as orifices and tubes, necessarily require secondary connecting indicators, recorders and totalizers that are hydraulically, electrically or pneumatically actuated. These have been developed in a great variety of design and principles of operation, but are not within the scope of this article.

Summary

This article comprehends a time period of approximately twenty centuries since the crude Roman adjutages. Nevertheless, despite all the advances made, the development of methods and equipment for the measurement and rate control of flowing water still occupies the study of hydraulic engineers.

W&SW

West Va. Legislature Makes Sewerage Financing Easier

The 1955 Legislature of West Virginia passed two bills designed to keep municipalities in the financing of major sewerage improvements.

House Bill 438 authorizes a municipality, which has received a pollution abatement order from the State Water Commission, to establish and collect sewer service charges and *accumulate and hold* the money in a special fund from which authorized expenditures for sewerage construction and operation may be made. The act provides for a public hearing prior to the adoption of a sewer service rate ordinance.

The companion House Bill 439 endeavors to establish a procedure for the financing of sewerage works through the sale of low interest general obligation bonds beyond the legal 5 per cent debt limit. The new law specifically authorizes a city to divert special service charges to general municipal use, thereby releasing tax money for the servicing of general obligation bonds. Special service charges are not classed as taxes and are outside of the tax limitation restriction. It should be emphasized that House Bill 439 provides no new method of financing but makes it possible for cities to use the general obligation bond method with its more attractive low interest costs.

West Virginia cities now have several sewerage financing methods or combinations of methods at their disposal, and they can tailor their financing programs to meet particular local problems.

Although not of direct interest to municipalities, another amendment to the West Virginia Code specifically authorizes county courts to take over and operate "orphan" sewers in unincorporated areas. The act provides for the establishment of a special fund for operation and maintenance costs, with the money to be derived through a levy of sewer use charges. West Virginia cities with bad sewerage conditions in fringe areas can work with county courts in solving these ofttimes vexing problems.

Water Dept. Employee Suffers "Innocent By-Stander" Beating

When Emmitt Austin, night emergency man in the Distribution Department of the Indianapolis, Indiana, Water Company investigated a commotion outside the office recently, he found one man beating up another. Then the man started to work on Austin, pounding him heavily around the chest and finally stabbing him in the left shoulder.

Austin finally was able to get to a room where Job Rating Committee members were in session. He was taken immediately to the Industrial Clinic for treatment. The attacker fled, but was later picked up by the police and jailed on an assault and battery charge.

1955 AWWA Chicago Conference

2—Technical Digests, Water Purification Division

The general story of the conference, including social events, exhibits, officers elected, awards and honors, was published in the August issue of W&SW.

THE WATER Purification Division of the AWWA held four technical sessions during the 75th Annual Conference, held in Chicago June 12-17. Two of the sessions were devoted to papers discussing a variety of treatment problems and operating processes, one session was comprised of five papers under the general title "Research Projects — Progress and Planning", and the final session included the Division business meeting and presentation of Task Group Reports. All sessions were well attended, the audience at times taxing the capacity of the meeting room.

Water Quality Problems

At the first session of the Division, the presiding officers were William Yegen, Superintendent, Water Filtration Plant, Bismarck, N. D., chairman; H. C. Medbery, Engineer of Water Purification, Water Department, San Francisco, Calif., co-chairman; and H. H. Gerstein, Chief Filtration Chemist, South District Filtration Plant, Water Purification Division, Chicago, Ill., associate presiding officer. The technical papers provided information on corrosion, fluoride estimation, biological infestation of purified water, and the action of chlorine residuals on water mains.

"Effect of Water Quality on Various Metals" was described by Lee Streicher, Chief Chemist, Metropolitan Water District of Southern California, La Verne, Calif.

Mr. Streicher reported on an extensive study of aftergrowths and deposits correlated with water characteristics. The investigation included examination of deposits in meters, apparently zinc carbonate derived from dezincification of galvanized water lines. This condition was caused by acid cleaning, and the resultant blisters were not removed by water rinsing. The corrective treatment developed is to clean the parts by buffing only (using no acid); the application of no-oxide grease has proven successful, and a new silicone grease is giving promising results.

Chemical analyses of water from three sources were illustrated in lantern slides: Colorado River water (Metropolitan Water District supply), Owens River water (Los Angeles aqueduct supply), and Long Beach well water. The untreated characteristics and the treated characteristics were listed. Strips of 13 individual metals and 8 sets of coupled metals were placed in the six types of water to determine the effect of water chemistry and water velocity on the metals after 235 days exposure.

The published paper will provide much useful reference data on methods of reducing corrosion in system operation, including substitution of buffing for acid treatment in cleaning meter discs and use of red brass and copper for yellow brass and zinc metals for waters of specified chemical characteristics.

Some of the Presiders

H. C. Medbery — H. H. Gerstein — Paul Weir — Sherman Russell

Fluoride Estimation

"Problems in Estimating Fluorides in Water" were described in a comprehensive paper presented by H. P. Kramer, Chief of Training, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

What is needed, according to Mr. Kramer, is a wide-range specific test, easily and accurately executed. The personnel regulating and controlling fluoride treatment have found a colorimetric test most successful. However, the present methods have serious limitations, which he described in detail.

Mr. Kramer described an "ideal" test for fluorides, and explained the application of current methods to meet the ideal standard as nearly as possible. He reported that the search for a more nearly ideal method will continue unabated.

That the fluoride test is a matter of present concern was evident in the discussion which followed. Among various aspects of fluoridation treatment, the drop-off of residual fluoride concentration appeared to be of considerable interest.

Biological Infestation

"Biological Infestation of Purified Water" was the title of a symposium introduced and summarized by M. P. Crabill, Superintendent of Purification, Indianapolis Water Co., Indianapolis, Ind.

Mr. Crabill noted that the biological infestation of purified water is a problem rather frequently encountered. He cited experience at Indianapolis with the growth of copepods, which proved susceptible to destruction by chlorination (providing 1.5 ppm residual free chlorine after 45 minutes contact time); this treatment killed the adult forms, but not the eggs. The eggs passed through rapid sand filters and hatched in the distribution system. Cuprichloramine treatment has been found an effective treatment for copepods, using 3.0 ppm copper, 0.5 ppm chlorine, and 0.15 ppm ammonia, with a 4-hour contact period.

"Bloodworms" were described by Professor J. K. G. Silvey, Chairman, Division of Science, North Texas

State College, Denton, Texas.

Stored water supplies provide nutrition for the growth of chironomous, commonly known as bloodworms, the immature midge flies. The worms can live in water having an ample, low, or zero concentration of dissolved oxygen.

The most obvious method of control is to cover reservoirs, so that the flies cannot lay the eggs. Filtration will remove the bloodworms. Among chemicals suitable for control copper chelate is especially effective, 10 ppm being lethal after 24-hour contact. Chlorine treatment requires 7 ppm, and chlorine dioxide 5 ppm, after 24 hours. A mixture of 4 ppm copper chelate and 3ppm chloramine will also be toxic to the bloodworms in 24 hours.

"Snail and Clam Infestation" was discussed by W. M. Ingram, Biologist, Public Health Service, Division of Water Pollution Control, Ohio-Tennessee Drainage Basins, Cincinnati, Ohio, in a paper authored jointly with C. M. Palmer, Head, Plankton and Water Supply Unit, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Mr. Ingram confined the discussion to reports of nuisance experiences, particularly with the "faucet snail", which has been found in Chicago's water supply, and with the "zebra clam", which has been reported in European supplies. The first is about $\frac{1}{8}$-in. long (a gill breather), and the latter is about $1\frac{1}{16}$-in. long (having an attachment organ to hold itself in the water flow).

Snails are mostly found in shallow water (where food is ample). They can be removed by coagulation and filtration. A bio-assay in the laboratory is required to determine chlorine and copper sulfate dosages needed for control.

In discussion, John Baylis (Chicago) cited experience demonstrating that live worms can go through filters. Elwood Bean (Philadelphia) noted that commercial photographers cannot tolerate a concentration of copper above 1.0 ppm in the public water supply. Ray Derby (Los Angeles) described the use of DDT in a reservoir (out of service, and lowered to about one-quarter of capacity) to control a heavy growth of midge flies which developed in a new aqueduct.

Chlorine and Water Mains

"Effect of Disinfection Doses of Chlorine on New Water Mains" was described by William Yegen, Superintendent, Water Filtration Plant, Bismarck, N. D.

In his city there has been an unprecedented building boom (following the discovery of oil in North Dakota in 1951), which has led to the installation of many new water mains. Crude main sterilization using hypochlorite has been replaced by chlorination to provide a residual of 100 ppm (or higher) and using a 24-hour contact period. Taste complaints and increases in the iron content of the water were caused by the main sterilization practice.

It was decided to substitute cement lined pipe for bitumastic lining, and to use only a 50-ppm chlorine residual with a 1-hour contact period. Experience at Bismarck indicates that in a bitumastic lined pipe, a chlorine residual of 100 ppm held for 45 minutes will cause some damage and iron pick-up. The AWWA specification permitting use of 10 ppm residual should be most satisfactory for any type of pipe.

L. Streicher

J. K. G. Silvey

H. O. Hartung

Programmers

DESIGN, INSTRUMENTS, and DETERGENTS

A panel discussion and two technical papers comprised the second Purification Division session. Presiding were: Paul Weir, General Manager, Water Works, Atlanta, Ga., chairman; William Yegen, co-chairman; and Sherman Russell, Superintendent of Water Purification, Atlanta, Ga., association presiding officer.

"Unique Features in Water Treatment Plant Design" was the title of a panel discussion presided over by H. O. Hartung, Superintendent of Production, St. Louis County Water Co., St. Louis, Mo.

W. W. Aultman, Consulting Engineer, Alvord, Burdick & Howson, Chicago, Ill., discussed the relationship between unit size and capacity costs for filters and filter equipment. Both economic considerations and flexibility are important, and Mr. Aultman related these considerations to the design of Chicago's new filtration plant.

C. M. Bach, Superintendent of Water Treatment, Minneapolis, Minn., described and illustrated the specifications in design required by the Minnesota State Health Department to eliminate hazardous features.

T. M. Riddick, Consulting Engineer, New York, N. Y., reviewed in detail a semi-automatic filtration, 4-5-mgd plant designed and constructed for Oneida, N. Y. A variety of ingenious features incorporated in this plant resulted in a cost of $100,000 per million gallons of capacity, a reduction of about 40 per cent over conventional construction costs.

The open discussion demonstrated much general interest in matters of floc destruction between settling basins and filters, filter rates above the conventional 2 gallons per square foot per minute, and preconditioning of raw water.

Plant Instrumentation

"Recording Instrumentation in Water Treatment Plants" was a topic discussed by Oscar Gullans, Chief Filtration Chemist, South District Filtration Plant, Chicago, Ill.

Mr. Gullans reported that the operation of Chicago's plant depended primarily on the operation of 352 measuring and recording devices. Close capacity tolerances are required, since the plant originally designed for a 320-mgd rate operates for a part of the time at a 550-mgd rate.

Filter controllers depend on air pressure, and a weekly maintenance schedule for valves is important. Clean air is essential, as some openings in air lines are only of 0.007-in. diameter. Chlorine residual recorders and sand expansion recorders are control devices which have proven especially valuable. As more and more automatic control equipment comes into use, ruggedness and simplicity are increasingly important. This equipment can contribute materially to better and more dependable water quality.

W. W. Aultman

T. M. Riddick

O. Gullans

Programmers

Detergents and Water Treatment

"Effects of Detergents on Water Treatment" were reviewed by J. C. Vaughn, Assistant Chief Water Chemistry Engineer, South District Filtration Plant, Chicago, Ill., and his paper was discussed by Charles D. Gates, Associate Professor of Sanitary Engineering, School of Civil Engineering, Cornell University, Ithaca, N. Y.

Mr. Vaughn summarized troubles caused by detergents in water treatment, including foam, tastes and odors, coagulation problems, and water quality deterioration in distribution systems. At Chicago, the ammonium sulfate was found to contain a detergent (added as an anti-caking agent), and such chemicals are not accepted for use.

In laboratory studies, aluminum sulfate and activated silica coagulation, chlorine dioxide, ferrous sulfate, and activated carbon have been partially effective in detergent removal. Both alum and iron sludges have been found beneficial when returned for detergent removal (their action is considered a surface absorption phenomenon). The dilution factor in Lake Michigan water is too great for detergents to constitute a problem of significance in water treatment, but the studies reported are of wide interest to the water works industry.

Professor Gates reviewed the entire problem, discussing such aspects as buildup in re-used waters, detergent identification, and uniform reporting. A study supported by NIH funds is underway at Cornell to determine the effect of chlorine (10 ppm) on A.D.F. (10 ppm). Results to date indicate that there is no 24-hour chlorine demand or reduction in the A.D.F.

The study also includes an investigation of surfactant effect on sand filter performance. This has so far indicated that a progressively faster loss-of-head rate may occur in the presence of detergents.

Radioactivity in Water Treatment

The third technical session of the Division was devoted to problems developing from new considerations of radioactivity. Presiding officers at this session were: H. C. Medbery, chairman; P. D. Haney, Consulting Engineer, Black and Veatch, Kansas City, Mo., co-chairman; and W. W. Aultman, association presiding officer.

"The Magnitude and Treatment of Nuclear Reactor Wastes" was the topic of a paper presented by W. A. Rodger, Association Director, Chemical Engineering Division, Argonne National Laboratory, Lemont, Ill.

He provided an excellent summary statement of the coming problem, and reviewed known methods of handling by dispersal, partially controlled containment, and complete containment. He developed an estimate of the volume of waste products to be produced from nuclear power reactors of the capacity contemplated in accepted predictions of installations to be made: this is on the basis of 2.2×10^6 megawatts capacity in the United States within the next fifty years. Reactors having such capacity will produce about 1 ton per day of long-lived isotopes in U. S. installations, and the world total within fifty years is estimated to be about 3 tons per day of such wastes.

Dispersal of these wastes in water for disposal cannot provide the answer, because of the incredible volume of dilution water which would be required. The containment of these wastes, based on a cost estimate of $1.00 per gallon, would cost $2 billion per year; or about $0.004 per kilowatt-hour of power capacity. Thus, nuclear power reactors using processes producing a smaller volume of wastes, or using enriched uranium, or methods of concentrating wastes, may be found advantageous.

Mr. Rodger provided estimates of approximate costs for processing the radioactive wastes. Per 1000 gallons, evaporation will cost $100; flocculation $10; ion exchange $10; and electrodeionization $10. At present, the economical method appears to be a combination of evaporation and ion exchange. For ultimate disposal of the concentrated radioactive waste, the most promising methods are evaporation and then concentration in concrete, or in clay which then is fired, or a fluidizing method. Where to put the final concentrated packages? The oceans are not the answer, because control would no longer be possible. Probably storage in a large abandoned mine would be the ultimate answer.

Water Treatment Methods Studied

"General Review—Studies of Water Treatment Methods to Prevent Radioactive Pollution" was presented by H. Gladys Swope, Senior Chemist, Chemistry Engineering Division, Argonne National Laboratory, Lemont, Ill.

Miss Swope described significance of tolerance levels established for radioactive elements in water supplies. The most important is strontium 90. By coagulation (at a pH of at least 12) a removal of at least 95 per cent can be accomplished. This treatment method is the most promising of all practical methods.

Regulatory agencies have authority to assure adequate treatment and control over users of radioactive isotopes. Miss Swope reviewed recommenda-

J. C. Vaughn

H. G. Swope

R. Eliassen

Programmers

Committee Reports

Chemicals	Stand. Methods	Fluoridation	Syndets	Liq. Chlorine
J. E. Kerslake	R. L. Derby	J. C. Zufelt	P. D. Haney	L. L. Hedgepeth

tions and activities of the AWWA in the direction of control; Secretary Jordan has recommended that the Atomic Energy Commission assign control authority to suitable USPHS and state pollution control authorities to assure the prevention of water supply pollution.

Instrumentation and Radioactivity

"Instrumentation for Radioactive Pollution Studies" was described by H. E. Pearson, Research Chemist, Metropolitan Water District of Southern California, La Verne, Calif.

Mr. Pearson summarized the report of an AWWA Task Group which has sent a questionnaire to 125 U. S. cities having a population over 100,000. On the basis of 66 replies received, it appears that only 21 cities regularly sample water for radioactivity, have suitable instruments, or follow a bonafide testing program. Radioactivity testing instruments are owned by 23 state or territorial health department laboratories (about 200 instruments), and by 19 public or private water utilities (about 125 instruments). There are 13 states and 10 utilities having programs for training water plant operators in such work.

The survey indicates that only 11 states and 9 water utilities have personnel and equipment adequate for testing low-level examinations of radioactivity. The testing equipment previously recommended by this Task Force is not suitable for low-level testing, and Mr. Pearson described several devices developed and commercially available for the purpose. These instruments should be capable of detecting one-tenth of one-hundredth of the maximum permissible level concentrations of radioactivity. It is necessary to distinguish between gross radiation, alpha absorption, and alpha and beta absorption, in low-level radioactivity measurements.

When Mr. Pearson's paper is published in the *AWWA Journal*, it will provide specific references to the equipment needed for water works testing. An internal proportional counter is apparently the most suitable low-level testing device, and one such unit is already used by the East Bay Municipal Authority laboratory.

In discussion, Mr. Kramer described the operator training program offered by the Robert A. Taft Sanitary Engineering Center, Cincinnati, for instruction in problems of radioactivity in water supply.

Radioactive Fallout Report

"1955 Studies of Radioactive Fallout" were reported by Rolf Eliassen, Professor of Sanitary Engineering, Massachusetts Institute of Technology, Cambridge, Mass., in a joint paper with R. A. Lauderdale, Research Associate at M.I.T.

Professor Eliassen first reviewed in simplified form the problem of fission product "ashes" which must ultimately be disposed of from nuclear power reactors. In the operation of such reactors, only the "primary" water will be radioactive — and also, perhaps, the wash waters deriving from ion exchange demineralizers.

He next reviewed the background of radioactive radiation and fallout resulting from atomic bomb tests, and described the planning of sampling stations at 22 water systems having open reservoirs in order to check the fallout direction and concentration caused by 1955 explosions.

For details, it will be necessary to await publication of Professor Eliassen's paper in the *AWWA Journal*. It may be said, however, that he emphasized particularly work done to date on water samples from Sebago Lake, supplying Portland, Maine, in studying concentrations of radioactive strontium. The water was described as entirely safe for use, containing from 100,000 to 1,000,000 times *less* than the maximum permissible concentration of radioactive strontium.

Division Business Meeting

In addition to the election of new officers (reported in the August issue of W&SW) and a discussion of the Water Purification Division program planning, the final session of the division was devoted to reports on progress by several of the Task Groups. Among these reports were:

"Specifications and Tests of Water Works Chemicals." Chairman Kerslake reported that there are 15 individual chemicals with completed and published specifications and tests. Two additional ones will be published this year, and only two remain to be completed.

"Standard Methods Committee." Chairman Derby reported on the completion and publication of the 10th Edition of "Standard Methods," recommending the reorganization of his committee, and the current development and revision of methods for the 11th Edition (with continuing publication of methods in tentative form in the *AWWA Journal*).

"Fluoridation Materials and Methods." Chairman Zufelt reported that, since the 1954 report of his Task Group, 122 new installations of water fluoridation had been made and 8 had been discontinued, leaving a total of 114 additional installations.

"Effect of Synthetic Detergents." Chairman Haney reported that the report of this Task Group has been published in the August 1954 issue of the *Journal*. Another Task Group, to report only on analytical methods, has been formed under Chairman Vaughn.

"Specifications for Liquid Chlorine." Chairman Hedgepeth reported on chlorine quality and marketing problems which have developed a need for the work of this Task Group. The work of his committee will continue, so that the final report can both specify quality of product and define container handling in terms of inspection, cleaning, valving and loading.

Designing, Constructing and Maintaining Centrifugal Pumps

Part 7—Shaft Sleeves

by ROY CARTER and IGOR J. KARASSIK

Mr. Carter is manager of the Volute Pump Section, and Mr. Karassik is manager of the Multistage Pump Section, Centrifugal Pump Division, Worthington Corp., Harrison, N. J. This new series has been prepared by Messrs. Carter and Karassik to review characteristics of centrifugal pumps for water and sewage service.

THE SHAFTS of centrifugal pumps are usually protected from erosion, corrosion and wear at the stuffing boxes, at leakage joints, at internal bearings and in the waterways by renewable sleeves. The most common shaft sleeve function is that used to protect the shaft from wear at a stuffing box and the bare designation, shaft sleeve, generally implies a part serving that function.

As a result, shaft sleeves serving other functions are given specific names to indicate their purpose. For example, a shaft sleeve used between two impellers of a multi-stage pump, which sleeve in conjunction with the interstage bushing forms an interstage leakage joint, is called an interstage or distance sleeve.

As mentioned in the discussion of shafts, in an extremely small pump with shaft through the eye of the impeller, the use of shaft sleeves is not advantageous. It is more economical to use a shaft with suitable corrosion and wear-resistant properties, renewing the whole shaft when wear occurs.

In medium size centrifugal pumps with two external bearings on opposite sides of the casing, the common double suction and multi-stage varieties, the favored shaft sleeve construction at the stuffing boxes is one in which the sleeve is held in axial position against the impeller hub by an external shaft nut. The shaft sleeve is prevented from rotating by a key, usually an extension of the impeller key, as illustrated in Fig. 1.

If the pump has considerable axial thrust for some reason so the frictional grip of the impeller on the shaft is exceeded, this axial thrust is transmitted through the sleeve to the external shaft nut. In larger high head pumps, the possible axial load on the sleeve may be high, favoring a design as shown in Fig. 2, which has the added commercial advantage of a simple, less expensive sleeve to be replaced when worn.

A few manufacturers have favored a sleeve design such as shown in Fig. 3, in which the impeller end of the sleeve is threaded and screwed on a matching thread on the shaft. With this type of sleeve a key cannot be used and right- and left-hand threads are used so the frictional grip of the packing on the sleeve will tighten it against the impeller hub.

With sleeve designs as in Figs. 1 and 2, right-hand threads are usually used for all the shaft nuts, as the sleeve is prevented from rotating in the shaft by keys. As a safety precaution the external shaft nuts, as in Figs. 1 and 2, and the sleeve itself, as in Fig. 3, have set screws as a locking device.

In pumps with overhung impellers, sleeves take various forms. Often the stuffing boxes are close to the impeller and the sleeve actually protects the impeller hub from wear, as in Fig. 4. Having a portion of the sleeve fitting on the shaft allows holding it from rotating by the impeller key, while it is held in an axial position because a portion of the sleeve is clamped between the impeller and a shoulder in the shaft.

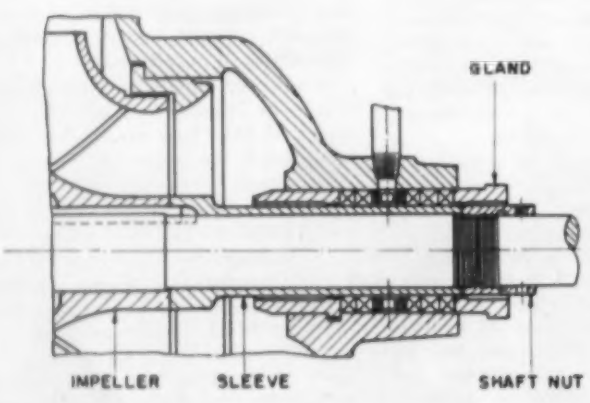


Fig. 1—SLEEVE with external lock-nut and impeller key extending into sleeve to prevent slip

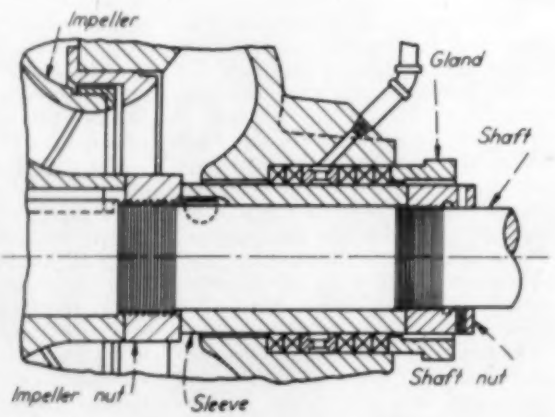


Fig. 2—SLEEVE construction with internal impeller nut, external shaft sleeve nut, and separate key for sleeve

With a metal-to-metal joint between the sleeve and the impeller hub, as in the designs illustrated in Fig. 1, there is often leakage of liquid through this joint into the clearance space between the shaft and the sleeve if the pump has a positive suction head. For a pump operating with a negative suction head, the various clearances may cause a slight leakage of air into the pump.

Generally such a leakage of air or liquid along the shaft is of no importance, but occasionally it does cause trouble. In those cases a design of sleeve incorporating a seal to prevent such leakage is desirable. One possible arrangement, as applied to a sleeve design as in Fig. 1, is shown in Fig. 5.

Another design, used for high-temperature process pumps, is shown in Fig. 6. In this, the contact surface of the sleeve and shaft is ground at a 45° angle. That end of the sleeve is locked, but the other end is free to expand with temperature changes.

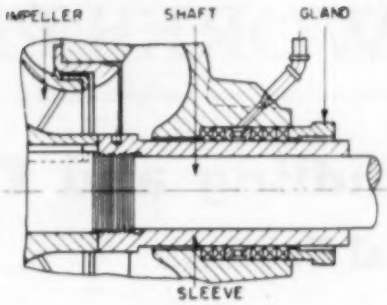


Fig. 3—SLEEVE threaded onto shaft, no external lock nut

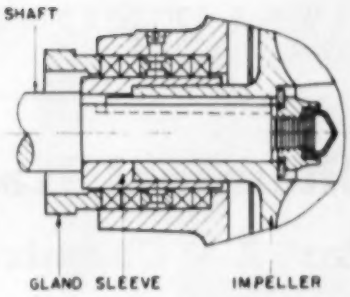


Fig. 4—SLEEVE for pumps with overhung impellers having hubs extending into stuffing box

Materials Used for Stuffing Box Shaft Sleeves

Stuffing box shaft sleeves are surrounded in the stuffing box by the packing. Therefore, the sleeve must be smooth so it can turn in the packing without generating too much friction and heat. Thus, the material used for such a sleeve must be capable of taking a very fine finish, preferably a polish. Cast iron, therefore, is not suitable.

For pumps handling clear water, a hard bronze is generally used, but some prefer chrome or other stainless steels. For sewage and other water services where grit is present, hardened chrome or other stainless steels give good results. For more severe services, stellited sleeves are often used.

Some use has been made of sleeves that are chromium plated at the packing area. In general, however, it is cheaper and more satisfactory to use a sleeve made entirely of a hardened chrome steel.

Maintenance of Shaft Sleeves

The shaft sleeves are, for most applications, the parts of a pump most seriously subject to wear and most frequently requiring replacement. After the sleeves have been worn appreciably, it becomes impossible to adjust the packing to prevent excessive leakage. As a matter of fact, excessively worn sleeves will frequently tear and score new packing as soon as it has been inserted. Thus, sleeves will frequently require repair or replacement when no other pump overhaul is necessary.

Generally sleeves of single-stage and the lower head multi-stage pumps can be removed from their shafts quite easily. The long sleeves sometimes used in high-pressure multi-stage pumps may be hard to remove and many pumps of that type have sleeves with external grooves so a sleeve puller can be used. With a sleeve construction as in Fig. 2, with an impeller nut between the sleeve and the impeller, a tight sleeve can often be backed off slightly and hence loosened by backing off this impeller nut. Usually a worn sleeve is replaced and not reconditioned. Therefore, it can be hammered to expand or crack it. If that is necessary, care should be exercised to prevent damaging the shaft.

Shaft sleeves are sometimes reconditioned by welding or metal spraying and final grinding. Such a procedure is not recommended for pumps operating in severe service or unless existing facilities for the final grinding are adequate. Not only is it necessary to assure concentricity of grinding, but also the perpendicularity of the sleeve radial faces with the sleeve bores. The concentricity should be checked again after reassembly on the rotor.

If the wear and grooving of the sleeve is of a very minor nature, say under 1/32 in., and if the service is not too severe, it may be possible to refinish the sleeve by grinding it slightly undersize. When the sleeve is so repaired, the clearance at the bottom of the stuffing box between the sleeve and the casing or stuffing box throat bushing should be checked to see that the packing will not be forced through the enlarged clearance space into the pump when the glands are tightened up.

W&SW

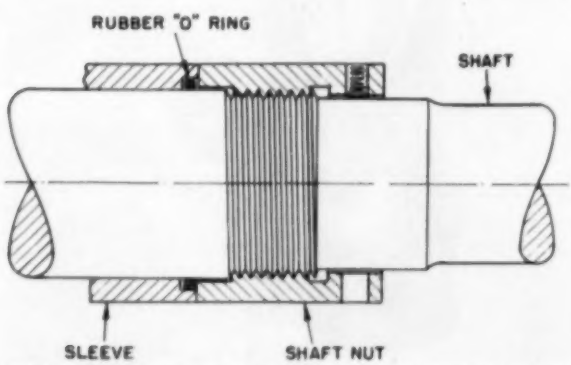


Fig. 5—SEAL arrangement for shaft sleeve to prevent leakage along the shaft

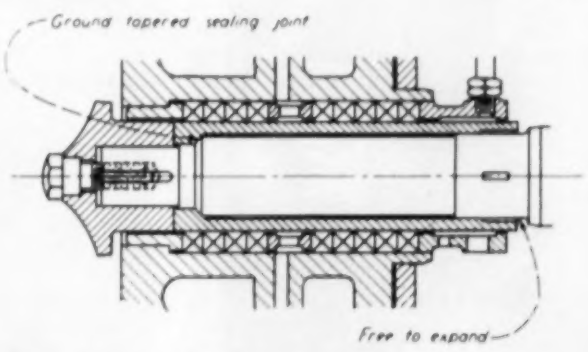


Fig. 6—SLEEVE with 45° bevel contacting surface

WATER WORKS PRACTICES

Chemical Handling and Feeding

Part 2 — Chemical Feeders

The Twenty-third of a Series

by GEORGE E. SYMONS, Ph.D.

Dr. Symons is Consultant and Technical Editor, Larchmont, N. Y. In this series he discusses *Water Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

PART 1 OF this lecture dealt with chemicals, their use, characteristics, handling, storage, materials for handling and safety factors. Part 2 deals with chemical feeders.

A . . . Chemical Feeders

1 . . . DEFINITIONS

a. *Chemical feeder:* Device which will deliver a chemical reagent from a storage container to the medium to be treated, at a rate of delivery which is relatively uniform and can be controlled; it is essentially a metering device since it measures the quantity of chemical being delivered.

b. *Dry chemical feeder:* Feeder which measures and delivers a dry chemical either directly to the medium to be treated or to a dissolving chamber or wetting chamber from which a solution or slurry is discharged.

c. *Volumetric feeder:* Dry feeder measures the dry chemical by volume; it has an accuracy of plus or minus 5 per cent by weight.

d. *Gravimetric feeder:* Dry feeder which weighs the material being discharged; it has an accuracy of plus or minus 1 to 2 per cent.

e. *Liquid feeder:* Feeder which measures the volume of liquid chemical or chemical solution being discharged; it may be an orifice, a pump, a proportioning pump or rotating dippers.

f. *Proportioning feeder:* Feeder which operates at a rate controlled by and in direct proportion to the rate of flow of the medium being treated; this is termed proportional pacing.

g. *Gas feeder:* Feeder which measures and controls the volume of gas discharged (either directly or through a solution chamber) to the medium to be treated.

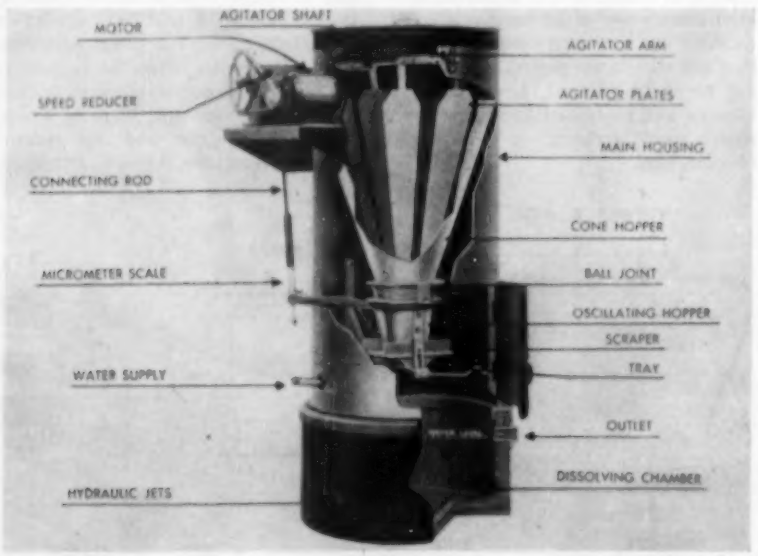
h. *Types of control:* (Manual, semi-automatic, programmed, proportional and automatic.) These are defined in Lecture No. 21 on Instrumentation and Control.

i. *Rate of feed:* Amount of chemical delivered in pounds per hour or pounds per 24 hours.

j. *Dosage rate:* Weight of chemical being added to medium being treated;

(Infilco Photo)

VOLUMETRIC feeder, oscillating plate.

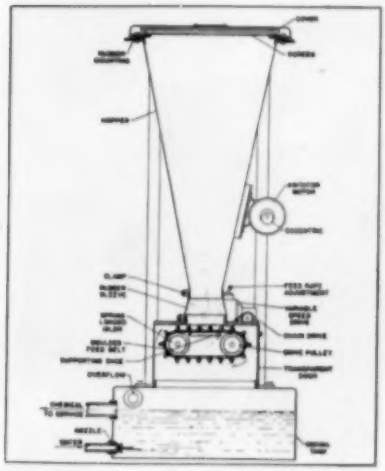


(Omega Photo)

VOLUMETRIC feeder . . . oscillating throat type.

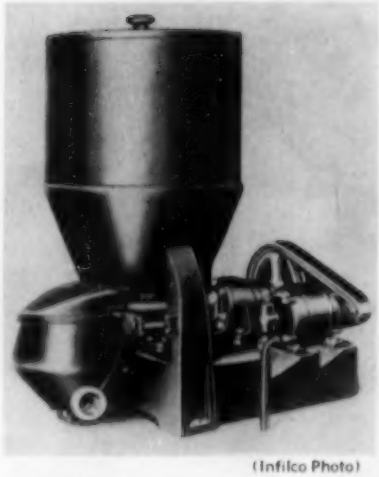
(Omega Photo)

VOLUMETRIC feeder . . . rotating disc type with loss-in-weight recorder.



(Permutit Photo)

VOLUMETRIC feeder . . . displacement belt-feed type.



(Infilco Photo)

VOLUMETRIC feeder . . . revolving table type.

usually expressed as lb per mil gal or ppm.

k. *Angle of repose:* That angle at which material just fails to slide on itself.

l. *Angle of slide:* That angle of slope which will cause a material to start to slide on a surface other than itself; angles of slide are usually a few degrees less than angles of repose.

2 . . . TYPES OF DRY FEEDERS[1][2]

a. Volumetric.

(1) Oscillating plate — a plate or pan moves back and forth under the hopper outlet and carries the chemical from under the hopper to a point where it will drop off when the plate retracts.

. . . Adjustment of feed rate is controlled by an adjustable gate which determines the depth of chemical in the plate and by adjusting the length of the oscillation of the plate. (There are several variations of this system.)

(2) Oscillating throat—the lower part of the conical hopper is fitted at the bottom with a ball joint making a dust-tight movable connection with an oscillating throat, which moves back and forth above a stationary table on which the chemical rests. Movement of the throat moves a scraper on the tray, thus pushing the chemical first from one end, then the other.

. . . Feed rate is controlled by adjusting the height of the table thus controlling the depth (volume) of chemical discharged with each movement.

(3) Rotating disc — (or rotating table) — the chemical is discharged from a hopper through a downspout to form a cone on a table. As the table is rotated a plow or wiper mechanism slices off part of the cone. New material descends to replace that sliced off.

. . . Feed rate is adjusted by controlling the rotation of the disc, the gap between the downspout and the table, and the setting of the plow.—Usually the latter two variables are used for rate control.

(4) Star feeder—a cylinder, with pockets, rotates within a tight enclosure at the bottom of the hopper and traps the chemical in the pocket discharging when the pocket faces downward to the dissolving chamber. It is also termed a rotary lock, vane, drum or wing feeder and is excellent for floodable materials.

. . . Feed rate is controlled by adjusting the drum speed.

(5) Screw feeder — the feeding mechanism is a horizontal screw utilizing a combination of rotary and axial movement through a feed trough discharging chemicals at both ends.

. . . Rate of feed is regulated by a cam operated clutch mechanism by means of a control crank.

(6) Ribbon feeder — the feeding mechanism consists of a slow moving feed roll which delivers a ribbon of chemical across the feed apron from which it is fed to the point of discharge.

. . . Rate of feed is regulated by varying the width of the ribbon and by change gears.

(7) Vibrating feeder—the feeding mechanism consists of a chute or table which throws, or backs away suddenly, rather than by pushing or trapping the chemical.

. . . This vibratory motion may be caused by single shaft vibrator driven by a belt, or by electrically operated magnets mounted above and below the feeder trough.

. . . Rate of feed can be controlled by the slope of the feed trough, by adjustable gate, and amplitude of the vibration.

(8) Miscellaneous—other feeders, infrequently used in water works practice, include stationary table with rotating plow, belt conveyor, chain feeder, plunger type feeder, and fluidized feeders.

b. Gravimetric

(1) Continuous — Consists of a short belt conveyor supported on a scale. The belt operates at a constant speed, and delivery is constant as long as belt loading is uniform and constant.

. . . The scale functions to maintain a constant feed to the belt, increasing the feed if load is below desired rate and vice versa.

. . . Rate of feed is controlled by speed of belt which may be controlled by a variable speed transmission. Other methods of controlling feed rates include adjustable gates, feed belts, screws and vibrators. Star feeders may be used to load the belt where floodable materials are handled.

(2) Semi-Continuous — Usually feed into a weigh hopper which cuts off and discharges when certain load has been reached.

(3) Loss-in-Weight — weighs out of scale balanced hopper, continuously at rate controlled by rate setter which continuously retracts the balance poise.

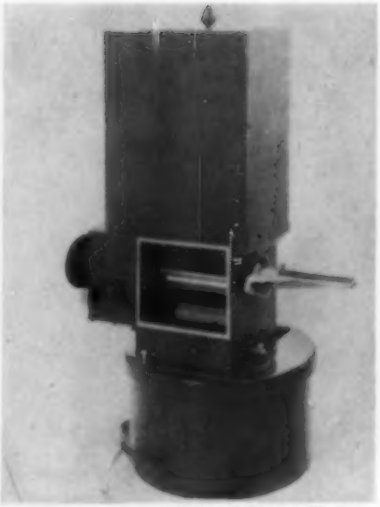
. . . This type is continuous except

(Syntron Photo)

VOLUMETRIC feeder . . . vibratory feed principle.

(Wallace & Tiernan Photo)

VOLUMETRIC feeder . . rotating screw type.



(Wallace & Tiernan Photo)

VOLUMETRIC feeder . . . ribbon feed type.

when the feeder hopper must be recharged.

c. Other Dry Feeder Types

(1) The volumetric and gravimetric feeders described above constitute the principal types used in water works practice.

(2) Other types of dry feeders include: Apron conveyor, belt conveyor, open drum, screw, chain, vibrator, fluidized, air slide, and spreader feeders. Most of these are used in process and other industries.

3 . . . TYPES OF SOLUTION FEEDERS[3]

a. Non-positive displacement.

(1) Decanter—Decanting outlet is movable vertically through depth of a solution tank. Rate of lowering of decant pipe is controlled by motor or timing device and thus controls rate of feed; operation of decant outlet may or may not be paced proportionately from flow of liquid being treated.

(2) Orifice

. . . Differential pressure—Utilizes the pressure drop across an orifice to displace the chemical solution from a reservoir.

. . . Constant head — Calibrated valve or variable orifice operates under a constant head in a solution tank.

. . . Variable head—Volume discharged is controlled by flow of solution from supply tank to the head over the orifice.

(3) Rotameter — Solution is fed

(Syntron Photo)

GRAVIMETRIC feeder . . . weigh-belt type.

(Wallace & Tiernan Photo)

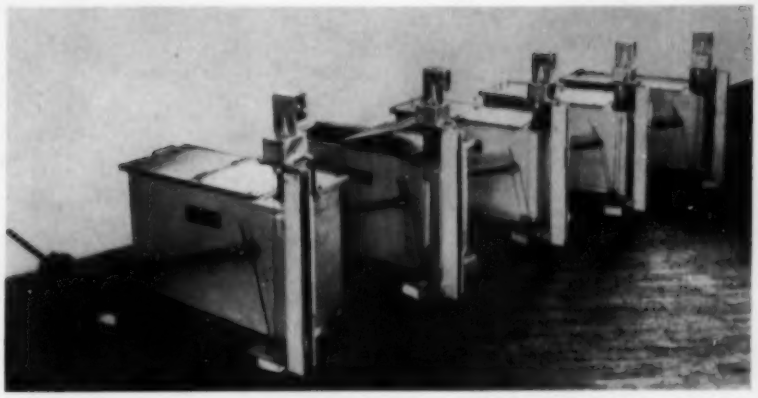
GRAVIMETRIC feeder . . . loss-in-weight type.

(Omega Photo)

GRAVIMETRIC feeder . . . loss-in-weight type, with dust collector.

(Permutit Photo)

SOLUTION feeder . . . proportioning decanter type.



(American Water Softener Photo)

SOLUTION feeders . . . battery of decanter type units.

through a rotameter-type metering tube under a vacuum created by an eductor. Chemical solution flow is controlled by a needle valve; this is in effect a calibrated valve or variable orifice.

(4) Crystal solution — Water passes over chemical crystals in a container and rate of feed depends on solubility of the chemicals; sometimes termed a "pot feeder" or a "saturator."

b. Positive Displacement

(1) Rotating dipper—Feeder consists of a tank, in which a constant supply of liquid is maintained by a float valve controlling the delivery from storage tank or pump, and a metering wheel (series of dippers on a wheel) rotating in the tank to lift the liquid and transfer it over a baffle to discharge to the treatment point. Rate of feed is controlled by speed of wheel which is controlled by a variable transmission with rate setter control.

(2) Proportioning Pumps

. . . Diaphragm—Reciprocating mechanism flexes a diaphragm alternately creating suction and discharge pressure; by combining two or three diaphragms in a single pump to operate on overlap cycles, a constant flow can be maintained.—Rate of feed is controlled by speed of reciprocating action; which can be controlled by manual stroke adjustment and variable speed transmission or other power control.

. . . Piston or plunger pumps—Reciprocating mechanism drives a piston or plunger in a cylinder alternately creating suction and discharge pressure. Two or more units can be operated on over-lapping cycles to produce constant flow. Rate of feed may be controlled by manual stroke adjustment and variable speed transmission.

. . . Gear pumps—Single or duplex units are available for continuous operation; ratchet mechanism gives intermittent feed.

(3) Drive mechanisms for positive displacement feeders include electric motor for all types, and for proportioning pumps, hydraulic or air ram, auxiliary take-off, and drive from water meter.

4 . . . GAS FEEDERS[4][5]

a. Gas feeders are utilized to control the addition of chlorine, ammonia and sulfur dioxide to water.

b. Gas feeders operate on the principle that gas flowing through an orifice causes a differential pressure which is related to the rate of flow of the gas. There are three methods by which this principle can be applied. (See Fig. 1)

(1) The orifice is constant, the pressure upstream from the orifice is variable and the vacuum downstream from the orifice is constant. (Method A)

(2) The orifice is constant, a vacuum upstream is constant and a vacuum downstream is variable. (Method B)

(3) The orifice is variable and a constant vacuum is maintained, both upstream and downstream. (Method C)

c. Chlorine gas feeders are classified in several ways.

(1) State of chlorine

. . . Direct feed, in which gas is delivered directly to the point of application (sometimes termed dry feed).

. . . Solution feed, in which chlorine gas is dissolved in a minimum amount of water and delivered as a solution to the point of application.

(2) Basis of design features (Applicable to solution feeders).

. . . Hydraulic—Utilizes hydraulic devices for pressure and vacuum relief with a bell jar arrangement.

. . . Hydraulic-mechanical of which there are two types—one uses a mechanical diaphragm-and-weight pressure regulator with variable orifice, and water tray and standpipe as part of the safety arrangement; the other utilizes a spring loaded mechanical diaphragm for the chlorine pressure reducing valve, a rotameter for gas flow measurement, and a tray and bell jar arrangement as a safety device.

. . . Mechanical—Uses no water tray; it has a rotameter for measuring gas flow rate and uses spring loaded mechanical regulators to reduce pressure, to maintain constant pressure differential and to act as a safety relief in case of vacuum failure.

(3) Method of applying vacuum

. . . Semi-vacuum type—Consists of a system in which vacuum is maintained in the device only during the time the eductor is in operation. If the vacuum fails, chlorine gas will continue to flow through the device, since there is no automatic shut-off.

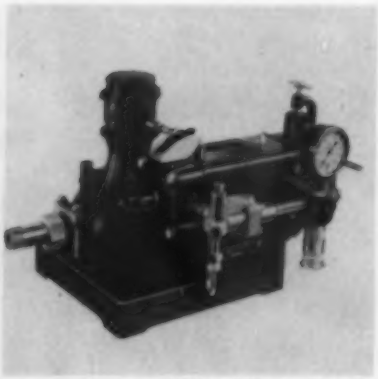
. . . Full vacuum type—Consists of a system in which chlorine gas is maintained under vacuum throughout the apparatus. The vacuum governs operation of the chlorine inlet valve (directly or indirectly) and chlorine will not feed unless there is sufficient vacuum induced through the apparatus.

(4) There are five commercial chlorine gas feeders available. All operate on the same basic principle (as discussed above) but may employ different methods of establishing that principle.

. . . The principle features of these chlorine gas feeders provide: Means for establishing a differential across an orifice to control chlorine feed;

(Lapp Insulator Photo)

SOLUTION feeder . . . positive displacement type.



(Wallace & Tiernan Photo)

SOLUTION feeder . . . proportioning displacement diaphragm type.

(Proportioneer's Photo)

SOLUTION feeder . . . positive displacement diaphragm type.

vacuum governed system; indicating device to show feed rate; means for setting feed rate; and safety devices.

. . . Details of the relationship of component parts of chlorine gas feeders are shown in articles published in *Water & Sewage Works* [4,5].

5 . . . MISCELLANEOUS FEEDERS

a. Slurries of lime or activated carbon may be fed to water supplies by diaphragm pump, Moyno pump or Rotodip feeder.

b. Lime slakers and feeders for feeding slaked quick lime consist of a dry chemical feeder mounted above a slaking compartment; the feeder may be gravimetric (belt type or loss-in-weight) or volumetric. The slaker compartment is equipped with a heat exchanger to assure slaking efficiency with cold water, with dust and vapor remover, and with thermostatic controls to prevent overheating.

c. Chemical feeders for the preparation and feeding of activated silica as a coagulant aid are of two types:

(1) Batch—Activated silica is produced by mixing a reactant and sodium silicate solution in proper proportions and aging the mixture for a definite time before dilution and storage.

(2) Continuous—The activated silica is produced, aged and fed continuously by properly controlled mixtures of reactant and sodium silica gel—there are two types of continuous feeders on the market.

. . . In one type a relatively small plastic cylinder, mounted on the back of a chlorine gas feeder, receives the chlorine solution from the chlorine feeder and mixes it rapidly with a solution of sodium silicate; the resulting activated silica solution is discharged to the point of application. This device can use only chlorine as the activating agent.

. . . In the other type, concentrated sodium silica solution is proportioned into a small mixing cell, to which dilution water and an activating agent are added in properly controlled proportions. The mixture is then aged for the proper length of time and discharged at the desired rate of feed.—This device can use any one of the several activating agents available (sulfuric acid, chlorine, alum, ammonium sulfate, sodium bicarbonate and carbon dioxide), it provides for variable aging time depending on the activating agent and an anti-gel interlock which prevents over neutralization of the sodium silicate, and it automatically rinses the system on shutdown.

B . . . Accessories to Chemical Feeders

1 . . . HOPPER AGITATORS

a. Because of the tendency of some dry chemicals to arch or hang up in the hopper above the feeder, it is common practice to install an agitator in the hopper, at a point above the hopper outlet.

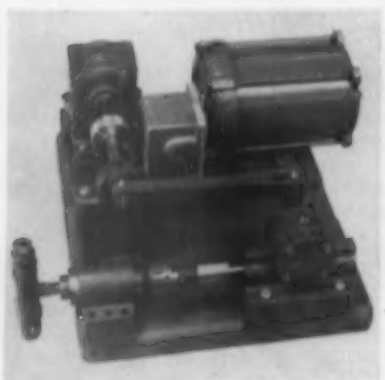
b. These agitators may be one of several types.

(1) Oscillating plates at the side.

(2) Vertical oscillating rods.

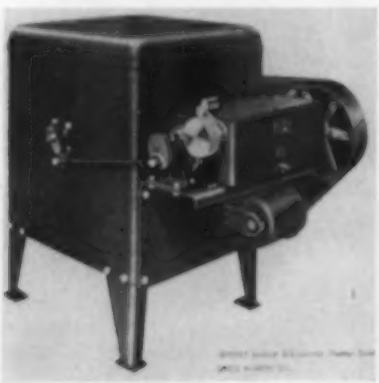
(3) Electric vibrator.

(4) Pulsating panels operated by alternating air pressure.



(Syntron Photo)

SOLUTION feeder . . . positive displacement piston type.



(Omega Photo)

SOLUTION feeder . . . positive displacement—rotating dipper type.

Milton Roy Photo)

SOLUTION feeder . . . positive displacement piston type.

(Wallace & Tiernan Photo)

CHLORINE feeder . . . earliest vacuum type via "Method B" of operation illustrated in Fig. 1.

(Everson Photo)

CHLORINE feeder . . . utilizes "Method C" of operation illustrated in Fig. 1.

(Builders-Providence Photo)

CHLORINE feeder . . . utilizes "Method A" of operation illustrated in Fig. 1.

2 . . . Dissolving Chambers

a. Although dry chemicals can be weighed or measured in that state, they should be dissolved before being added to the water undergoing treatment. Solutions of chemicals are more readily dispersed and mixed than solid particles.

b. Dissolving chambers, therefore become an integral part of the feeder rather than an accessory.

c. Dissolving chambers (sometimes termed dissolvers) may be of several types.

(1) Jet dissolver, in which by means of water jets, located at the bottom of the box, the liquid and solids are completely and rapidly mixed. Baffles in the dissolver assure the proper detention time for dissolving of the chemical at maximum feed rates.

(2) Wash down dissolver, in which the chemical drops into a cone where a stream of water is directed tangentially to the cone surface.

(3) Mechanical mixer, wherein agitation is provided by a rapidly rotating propeller.

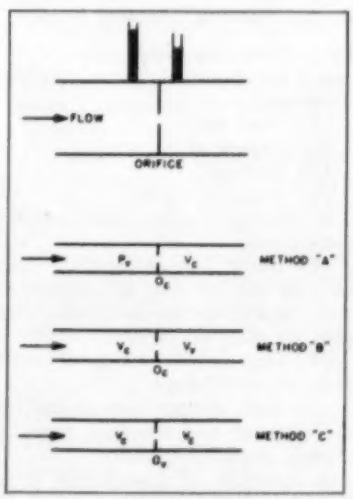
(4) Upflow dissolver, in which the chemical drops into an inverted cone filled with water which enters at the apex of the cone where much agitation is provided; as the water flows up in the cone the agitation subsides so that incoming chemical particles are not washed out in the overflow before being dissolved. This type of dissolver has its best application on granular chemicals of appreciable particle size.

d. Solution feeders for liquids and chemical solutions purchased as such require no dissolvers, only liquid storage capacity.

Solution feeders which add solutions made from dry chemicals require separate dissolving chambers or solution boxes where the measured chemical is added to a measured amount of water before storage.—This is batch preparation of solution whereas dry chemical feeders provide continuous preparation of solution as required.

3 . . . Bucket Elevators

a. Where chemical storage space is on the same floor as the chemical feeder, a bucket elevator is used to lift the chemical from a feed chute to the top of the hopper above the chemical feeder.



(From Water & Sewage Works)

BASIC PRINCIPLE involved in design and operation of four makes of chlorinators—(Fig. 1).

b. Bulk chemicals must be elevated to storage bins. Elevators for this purpose have been discussed under a previous section on handling and storage.

4 . . . Dust Collectors

a. Dust collectors for dry chemicals are usually of the bag filter type.

b. They may be installed on top of a dry feeder, or above filling chutes, hoppers and bucket elevators.

c. Properly designed dust collectors, remove the dust from the air in the device to which it is attached, prevent escape of dust into the room, and return the dust to the system without subsequent handling.

5 . . . Instruments and Controls

a. Instruments on the chemical feed system are of particular help in the control and record of operations.

b. Types of instruments include

(1) Totalizers.

(2) Indicators.

(3) Recorders.

(4) Combinations.

c. Information sought includes

(1) Feed rates (indicated or recorded).

(2) Chemical in storage, either dry or solution (indicated or recorded).

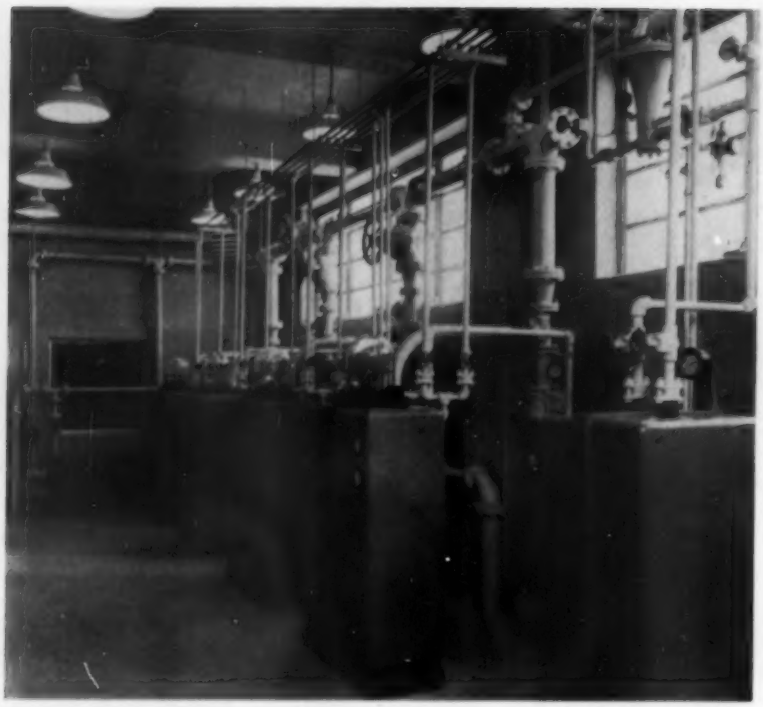
(3) Amount of chemical fed in time period (totalized).

d. Controls for chemical feeders are essential to proper operation.

(1) Types of control (manual, semi-automatic, programmed, proportional and automatic) are defined in Lecture No. 21 on Instrumentation and Control.

(Fischer & Porter Photo)

CHLORINE feeder . . . of recent design utilizes "Method C" of operation—see Fig. 1.



(Wallace & Tiernan Photo)

CHLORINATOR battery . . . illustrative of modern chlorinator installation, with chlorine evaporator on right, employs "Method B" of operation.

(2) The type of control chosen for a particular chemical feeding system depends on the purpose, size and complexity of the installation.

e. Panels, in which are mounted the instruments and controls, are useful accessories in a chemical feeder system.

(1) Bring all the functions together in one place.

(2) Improve appearance of installation.

(3) Simplify operation and control.

(4) Minimize maintenance.

f. Sentinel Alarms are essential to properly designed installations of chemical feeding systems.

(1) Types of alarms include warning bells, buzzers, horns, and lights.

(2) Situations calling for alarms include, over- or under-feeding, low, or empty storage facility, stoppage, overheating, etc.

6 . . . Other Accessories

a. Proportioning weir tank or flow splitter, for proportionately dividing the flow of a chemical solution or slurry to two or more points of application.

b. Manifolds for distributing chemical solution (particularly chlorine solutions) to several points of application.

c. Gravimetric scales for weighing chlorine containers, bags, pallets, or bulk storage. — Hopper weighing scales are built into gravimetric loss-in-weight dry chemical feeders.

d. Miscellaneous items such as bin level switches, belt shifters, rotary bin gates, timers, special electrical starting equipment, and extension hoppers.

C . . . Selecting Chemical Feeders

1 . . . Dry Feeders[6]

a. Operational Requirements must be defined as to

(1) Feed rate.

(2) Degree of accuracy.

(3) Records.

(4) Type of control.

b. Storage Requirements must be determined.

(1) Initial hopper capacity should be sufficient for 4 to 24 hours operation, depending on manpower available for shift operations.

(2) Bag or bulk storage should be from 60 to 90 days.

(3) Bulk storage bins should hold at least one and one-half times the normal shipping quantity.

c. Location of installation is important.

(1) Hydraulics of installation.

. . . If possible dry chemical should flow entirely by gravity from storage level to dissolving chamber and the solution should flow by gravity from dissolving chamber to point of application.

. . . Avoid, if possible, conveyors, pumps and ejectors.

(2) If ideal arrangement is not possible choose location that will require as little pump or ejector head as possible.

d. Type of Installation must be chosen.

(1) Small unit feeder where very low feed rate and small chemical storage capacity is required.

(2) Two floor installation, for either low or high feed rate with bin storage on the second floor.

(3) Mechanical loading installation (bucket elevator) for high feed rate and large hopper storage (on second floor) with bag storage on first floor.

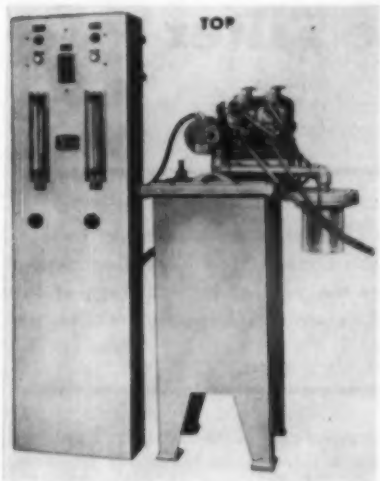
(4) Bulk storage bin installation for low or high feed rates where chemicals are purchased in truckload or carload lots.

e. Type of feeder must be selected.

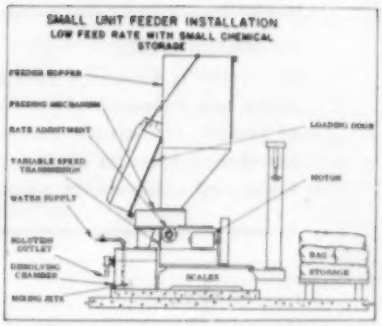
(1) Volumetric where

. . . Operation rates are relatively constant.

. . . Continuous or regular checks on performance are possible by operator.



(Omega Photo)
ACTIVATED SILICA . . . generator-feeder of continuous type.



CHEMICAL feeder . . . of especial interest to the smaller plants.

LIME SLAKERS . . . with loss-in-weight feeders mounted atop the slakers.

. . . Considerable detention capacity is available in mixing and settling basins to average out minor variations in feed rates due to changes in bulk density or feeding characteristics of the chemical.

(2) Gravimetric (belt or loss-in-weight) where

. . . Accuracy of feed rate of ±1 per cent is desired.

. . . Continuous or regular operator observation is not possible.

. . . Basin detention capacity is limited.

f. Accessories must be picked to suit the particular feeding operations.

2 . . . Solution and Slurry Feeders[3]

a. Operational requirements must be defined as to the same considerations as for dry feeders.

b. Storage capacity required must be estimated.

(1) Initial tank storage capacity at the feeder will depend on the availability of operators to make transfers from bulk storage.

(2) Bulk storage tanks should hold at least one and one-half times normal shipping capacity and allow for 60 to 90 days as a cushion against delivery tieups.

c. Location and hydraulics of installation is important.

(1) Suction lift and pumping head for positive displacement feeders should be at a minimum.

(2) Gravity feeders should provide sufficient fall to maintain feed lines in clean conditions.

d. Type of installation is determined by these factors.

(1) State of chemical, whether solution, suspension, or slurry.

(2) Whether feed is to be intermittent or continuous.

e. Type of feeder depends on many factors.

(1) Non positive displacement (decanter, orifice, rotameter) where—

. . . Operation rates are relatively constant.

. . . Type of chemical lends itself to this type of feeder.

. . . Proportional feeding is not required.

. . . Pot feeder can be used if solubility rate of chemicals.

. . . Particular feeder choice depends on factors concerned with specific application of the installation.

(2) Positive displacement (rotating dipper, proportioning pumps) where—

. . . Operation rates are variable.

. . . Proportional feeding is desired.

. . . Chemical discharge is under pressure (proportioning pump only can be used).

. . . Particular feeder choice (diaphragm or plunger pump or rotating dipper) depends on specific application of the installations.

f. Accessories, type of delivery mechanism, type of drive, etc., are picked to suit the particular feeding operations and the specific application of the installation.

3 . . . Gas Feeders[4,5]

a. Solution type feeders are chosen for water treatment installations.

b. Capacity, range of feed and safety features are important factors in selection of feeder.

c. Type of control, method of maintaining vacuum, life of materials of construction and other features must be given consideration in selection of the particular feeder.

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Material in this lecture was developed from these sources:

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2. Schworm, W. B.—"Manual of Chemical Feed Machines," Jour. of Mo. Wat. & Sew. Conf., Vol. 24, July 1953.
3. Henke, R. W.—"Chemical Feeding and Proportioning Equipment," *Ind. & Engr. Chem.* p. 684, April 1955.
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Next Lecture—Chemical Handling and Feeding—Part 3, Feeding Practices.

Tentative Test for Toxic Wastes New ASTM Publication

At the recommendation of ASTM Committee D-19 on Industrial Water, the ASTM Administrative Committee on Standards accepted for publication new Tentative Methods of Test for the Evaluation of the Acute Toxicity of Industrial Waste Water to Fresh Water Fishes (D 1345). This test provides information on the relative acute toxicity of the substance tested under prescribed experimental conditions. It is believed that the biological method will yield significant information on the character of industrial wastes not obtainable by strictly analytical procedures.

A Critique on the Membrane Filter

by MAXIM LIEBER

Mr. Lieber is Associate Sanitary Chemist in the Division of Laboratories and Research of the Nassau County (New York) Department of Health. His article points out the present shortcomings of the membrane filter as disclosed in extensive laboratory tests on potable and non-potable waters.

INTRODUCTION of the membrane filter (M.F.) has resulted in various opinions by numerous investigators. Attempts to apply this new bacteriologic technique to the examination of potable and non-potable water have resulted in a deluge of published material in scientific periodicals throughout the country. The manifold advantages of the membrane filter have been widely expounded. However, not enough emphasis has been placed upon its present shortcomings.

The staff of the Nassau County Department of Health Laboratory was impressed with the potentialities of the M.F. as disclosed in the original introductory articles. Therefore, when sufficient data from successive investigators became available, the Division of Laboratories and Research also attempted to apply the membrane filter technique.

From the start, application of the membrane filter to potable water did not appear practical. It should be realized that, from a Health Department level, it is necessary to examine water samples collected from several points on a distribution system. When an area such as Nassau County is divided into many water districts, the number of samples submitted to the laboratory becomes quite large.

To obtain the best results with the membrane filter, as applied to potable ground waters, it is essential that large volumes of the sample be filtered. This necessitates the use of sample bottles of approximately 1-liter capacity. Such bottles are impractical for use in large numbers on a field level when consideration has to be given to proper refrigeration during transportation.

The actual savings in time of analysis by the membrane filter also has been found to be unduly emphasized. A membrane filter usually is incubated for a total of 18 hours. It has been established from past experience that the majority of presumably potable waters, which are contaminated, will give a positive presumptive test (gas formation in lactose broth within 24 hours) according to the Standard Methods procedure. In most instances these positive presumptive tests result in a positive confirmation for the coliform group.

Therefore, a positive presumptive test is sufficient evidence to alert the sanitarian, pending the final confirmation of the analysis. It also has been generally noted that where the Standard Methods test on potable water

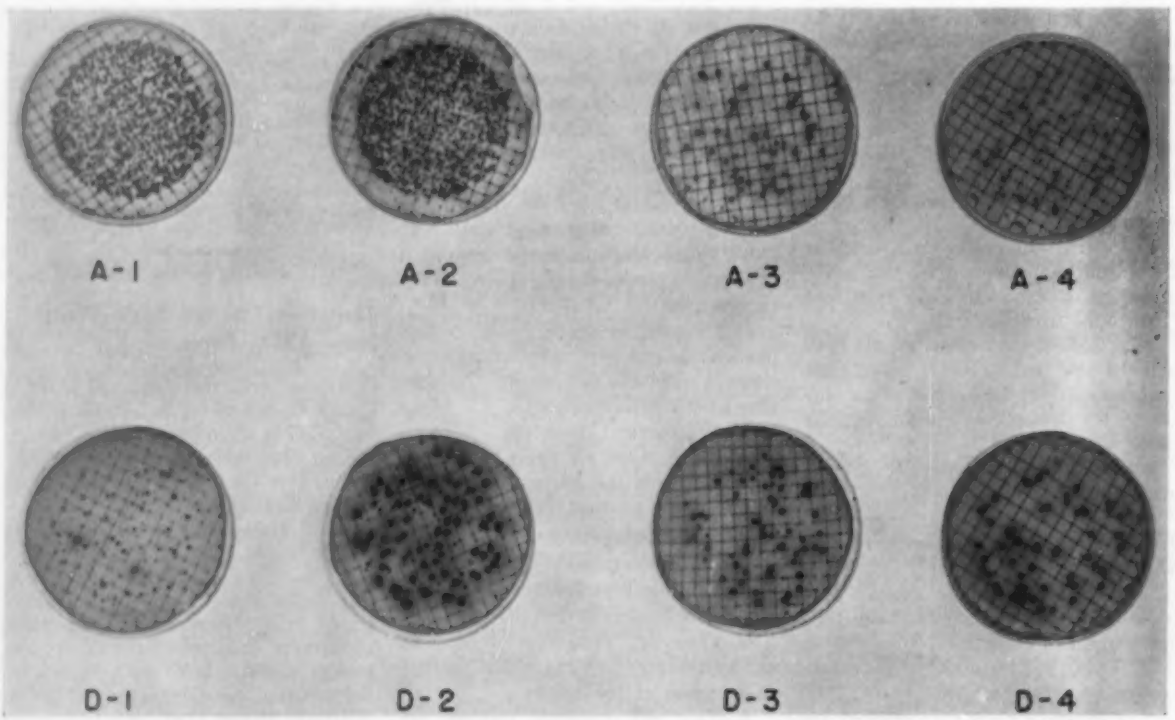


FIG. 1. COMPARISON of E.H.C. modified Endo medium and 15 per cent basic fuchsin Endo agar on tidal waters (see Table 1)

gives a doubtful presumptive result (gas formation in lactose broth at the end of 48 hours, but not in 24 hours), the membrane filter technique produces colonies whose visual characteristics are questionable as members of the coliform group.

The element of cost also has been considered in comparing the membrane filter with the Standard Methods procedure. Although it is extremely unusual with potable water, let us assume that all of the lactose fermentation tubes produced gas and that each of these tubes was confirmed with 2 per cent brilliant-green lactose bile broth. For the latter case, the total cost of the media would not exceed $0.07 per sample. The filter membrane presently available costs a minimum of $0.10 each.

When all the other aspects of the laboratory equipment needed in both methods of analysis are considered, it is difficult to visualize any noteworthy savings in cost between the two methods. On the contrary, it appears that at present the cost per analysis by the membrane filter exceeds that of the established Standard Methods procedure.

Therefore, although the potentialities of the membrane filter are excellent and warrant continued investigation, it is felt that the membrane filter has not been developed sufficiently to be used for the routine examination of potable water.

Experience with Non-Potable Waters

It is the policy of the Nassau County Department of Health to annually determine the coliform densities of tidal water for bathing and recreational purposes. Analysis of these waters by the Standard Methods procedure requires more work and time as compared to the examination of potable water. An opportunity was here presented for the advantageous application of the membrane filter.

To determine the applicability of the membrane filter to tidal water, initial M.F. tests were made using the Albimi M broth for a 2-hour enrichment period, and then transferring the M.F. to E.H.C. modified Endo medium for an additional 16 hours. Although several decimal dilutions were filtered, the resulting membrane filter appeared to have a heavy overgrowth. This made counting impossible. The overgrowth was apparently caused by the normal flora present in the tidal water tested.

To overcome the use of two media, similar series of membrane filters were prepared and cultured directly on fresh Difco Endo agar plates (which contains 0.04 per cent basic fuchsin), and on plates of a modified Difco Endo agar to which was added sufficient basic fuchsin and sulfite to give it a basic fuchsin content of 0.15 per cent. After 24-hour incubation, the 0.15 per cent fuchsin Endo media gave the best over-all reduction of the background growth, resulting in countable membrane filters.

On observing this effect, a series of samples was prepared according to Table 1. The samples were analyzed using the Albimi M. enrichment broth to E.H.C. modified Endo medium as compared to the modified 0.15 per cent fuchsin Endo agar.

TABLE 1

Identification of Samples Shown in Figure 1.

Albimi M. Broth to E.H.C. Modified Endo	Sample Filtered	Endo Agar with 0.15% Fuchsin
1 A	Raw tidal water	1 D
2 A	Raw tidal water + E coli culture	2 D
3 A	Sterile tidal water + E coli culture	3 D
4 A	E coli culture	4 D

The results, shown in Fig. 1, disclose the potential application of the improvised 0.15 per cent basic fuchsin Endo agar for coliform counts on tidal waters. An attempt was then made to apply this media to the membrane filter technique on a routine basis and in parallel with the Standard Methods confirmed test. The samples involved were the routine specimens submitted to the laboratory in 125-ml. sterile bottles. After the sample was inoculated in lactose broth, the residual sample was used for the membrane filter technique.

After a short time it became evident that several decimal dilutions had to be made with the membrane filter to bring it within counting range. The fluctuations in coliform densities were so great that three decimal dilutions had to be filtered. This procedure was adopted; otherwise a substantial number of samples produced a non-countable membrane filter.

The examination of tidal water by the membrane filter was of short duration. This method of examination had to be discontinued because:

1. The samples arriving at this laboratory are received in groups of 30 to 50 specimens. That creates a period of concentrated activity on using the membrane filter technique, which far exceeds that for normal inoculation into lactose broth.

2. The preparation of three decimal dilutions for membrane filtration on a substantial number of specimens also requires large quantities of sterile graduate cylinders, pipettes and buffered water.

3. The cost of analyzing each specimen by the membrane filter would average at least 30c for a minimum of three filters. (The cost of media in the M.F. procedure has not been considered.) That is much higher by comparison with the Standard Methods procedure, whose average cost for media is less than 10c per sample.

Conclusions

The application of the membrane filter to the bacteriologic examination of water possesses many possibilities. However, in its present state of development, the membrane filter procedure has many characteristics which prevent it from supplanting A.P.H.A. Standard Methods test. Its limitations revolve about the large volumes of potable ground water samples necessary for routine examinations, the increased cost per analysis by the membrane filter technique as compared with the Standard Methods procedure, and the undesirable concentration of laboratory activity resulting in the routine use of the membrane filter.

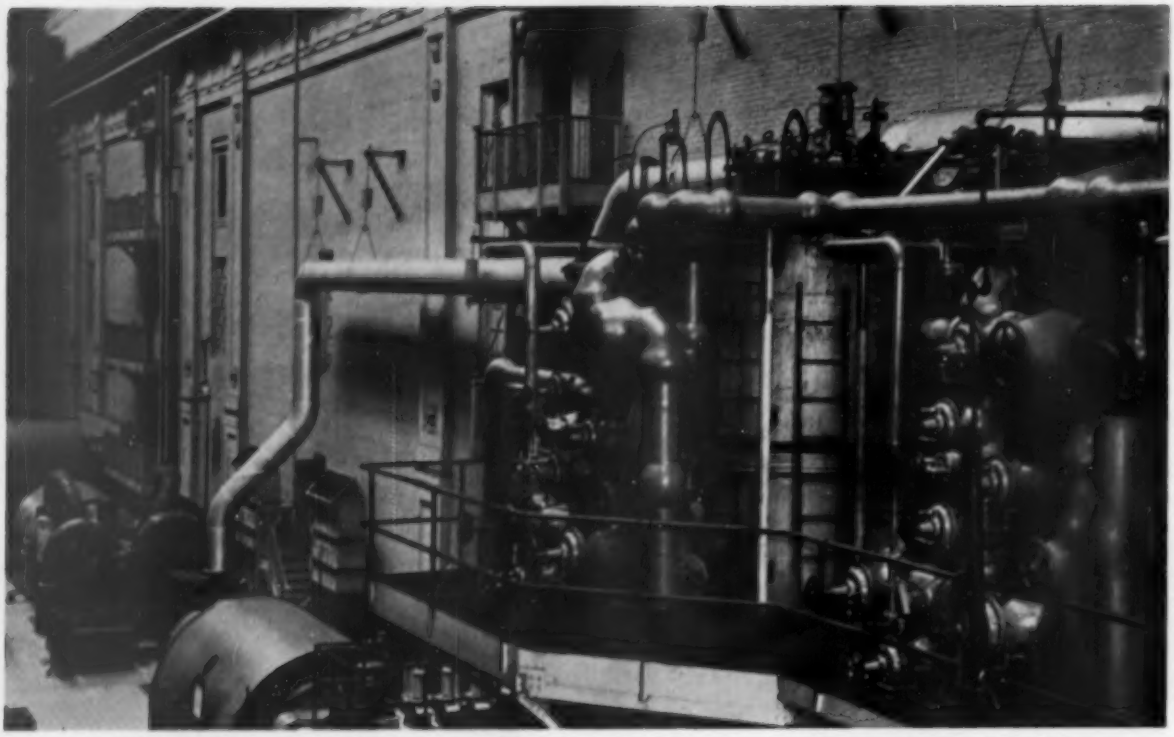
Chicago Begins Fluoridation of Water

Supplying 4,300,000 consumers, will be world's largest fluoride installation.

Orders have been issued by Mayor R. J. Daley to begin fluoride treatment of Chicago's water supply without delay.

The order was issued when the governor of Illinois vetoed a bill which would have required a city-wide referendum before Chicago could begin water fluoridation, which had been authorized by the City Council in June, 1954. Not only would the referendum have been required in Chicago proper, but in the 51 suburban communiites supplied water by the City of Chicago, as required by law. The population to be supplied, including the suburban areas, is in excess of 4,300,000.

To start the Chicago fluoridation program—the world's largest—an initial order to purchase $40,000 worth of fluoride has been issued.



THE WORLD'S largest mixed-bed demineralizing plant conditions water for steam-electric generation by using—

Water Without Minerals

by I. B. DICK

Mr. Dick is Assistant Chief Chemical Engineer for the Consolidated Edison Company of New York. In this article he describes the centralized controls, the instruments, the operation, and the results obtained in the world's largest mixed-bed water softening plant.

IN WHAT is believed to be the largest plant of its type ever built, demineralizing of 2,500,000 pounds of water an hour was the unusual problem successfully solved by power engineers in one of New York City's major steam-electric generating stations.

Steam and electrical power for most of the buildings in the city's midtown skyscraper district is supplied by the Waterside station of Consolidated Edison. The recently modernized plant —right next door to the big United Nation's Secretariat building—has a capacity of 658,200 kw and 6,460,000 pounds of steam per hour (at 1400 to 1710 psi and 950°F.)

All steam passes through six topping turbines discharging at 200 psi. As much as 1,800,000 pounds per hour of this steam feeds into the skyscraper heating systems. This process steam is not returned and must be replaced by makeup water. Blowdown, soot blowing and incidental losses increase the amount of makeup water needed so that the Waterside station's total requirements equal nearly 2,500,000 pounds per hour. This raw water comes from New York City's Croton and Catskill reservoirs, which have silica contents of 6.3 and 2.4 ppm, respectively.

Silica concentration, which in the past was around 30 to 35 ppm in the boilers, fouls the condensing turbines, requiring caustic washing of each every 4 to 6 weeks. This silica fouling increased generating costs through decreased turbine efficiencies and capacities; increased outage time and increased boiler blowdown, which wasted valuable heat, water and chemicals. With the zeolite softening equipment formerly used to treat makeup water, 6 per cent boiler blowdown was required to maintain the dissolved solids content of the boiler water at less than 200 ppm.

Preliminary studies revealed that the savings in operating costs realized by demineralizing the water justified a considerable capital investment for water treating equipment. This held true even though some savings in operating costs from silica-free water would be partly cancelled by the increased treatment costs of the makeup water.

Added to the problem of removing silica from 2,500,000 pounds of water per hour was the need to cope with a space problem. To keep pace with New York's expanding demand for power, the Waterside station has undergone many modernization programs. These programs have been so extensive that little remains of the original station except the shell—and even that has had its roof raised. Hence, space is at a premium and was a decisive factor in the selection of mixed-bed demineralization equipment.

Studies by Consolidated Edison's chemical engineers proved that evapo-

ration of the makeup water would be impractical and that ion exchange methods offered the only hope of solution. Pilot plant studies revealed that strong-base anion resins, when intimately mixed with cation resins, would remove silica to extremely low residuals. The studies also indicated that the two-bed demineralizers would also remove silica, but required more space, which was not available.

The solution to the problems was found in the use of the mixed-bed or monobed demineralized*. Six 11-foot diameter mixed-bed units, each rated at 1,000 gpm, with automatic controls and necessary pumps, tanks and piping, were installed on steel platforms under the roof and in a corner of the turbine room.

The first four units were started up in August 1954; the complete plant went into operation two months later. Because no data were available on the performance of mixed-bed demineralizers on New York City water, a small pilot unit was operated for a year and a half prior to starting the first units of the full-scale plant.

Results of Pilot Studies

Experience gained from the mixed-bed pilot plant studies resulted in a change of one of the resins, the development of a photoelectric colorimeter, and a change in regeneration procedure. During these tests, it was discovered that conductivity does not always break before silica; therefore, silica tests are necessary to determine bed exhaustion.

To permit rapid removal of an exhausted unit from service, it was decided that silica tests should be run by the operators at the plant site instead of by chemists in the laboratory. Unfortunately, commercially available colorimeters with the required sensitivity were unsuited for use outside the laboratory, but the staff successfully developed its own rugged colorimeter, which measures silica content down to 0.01 ppm. The studies also proved that when demineralization capacity is lost, presumably due to organic fouling, it can be restored by continuing caustic injection and rinse cycles of regeneration until the rinse is free of chlorides.

The plant design, amended by the results of the pilot plant studies, was proven to be amazingly satisfactory. It was so easily put into service that Consolidated Edison engineers continually expected major troubles to develop. They never did. Moreover, the plant has consistently produced water with a silica content less than 0.02 ppm and a conductivity averaging a little better than one micromho.

The water first passes through four hydrogen zeolite softeners operated in series. These softeners were part of the old split-stream zeolite softening plant installed in 1940 as the largest carbonaceous zeolite softening plant in the world. They were retained to permit the removal of bicarbonates by degasification rather than anion exchange, to filter raw water, and to remove calcuim — thereby preventing calcium sulfate fouling of the mixed-bed units.

From the softeners, the water is pumped through two decarbonators and then flows by gravity to rubber-lined wet wells. From the wet wells the water is pumped through the mixed-bed units to a bituminous coated storage tank. The mixed-beds are operated in parallel at full capacity, with units pulled in or out of service according to makeup requirements. Unlike cation softeners, these units can be taken out of service and then returned to service without any impairment of water quality.

Centralized Controls

Supervision of the entire triple-decker plant is centered in one small nook which includes the instrument panelboard, sampling table, and colorimeter for silica determinations. Regeneration of the beds may be done in any one of three ways:

1. Automatically with manual initiation.

2. Semi-automatically through remote manual pushbuttons on the panelboard.

3. Manually by means of handwheels at the valves.

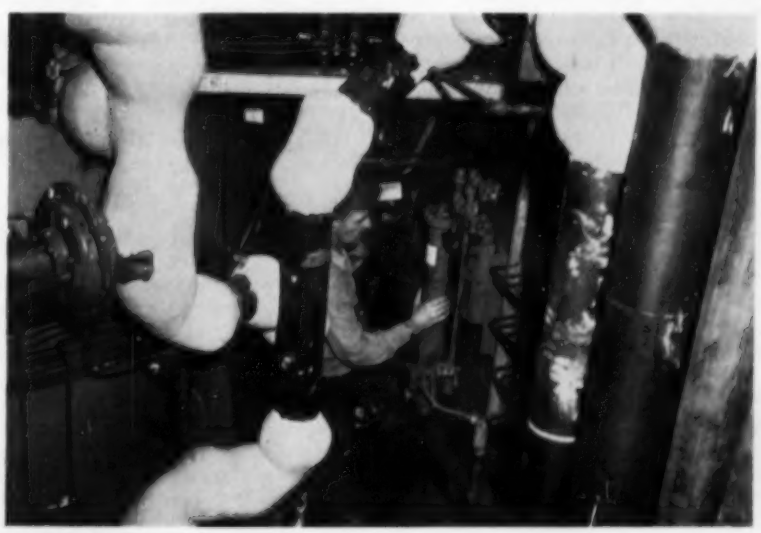
By the first method, the operator, upon checking silica or being warned by the conductivity recorder, merely presses a pushbutton to initiate the regeneration cycle. At the completion of the cycle the unit is returned to service or held in standby, depending on the setting of a selector switch.

The second, or semi-automatic, method permits the operator to stay at the panel but still open and close valves, start and stop pumps, and regenerate the beds manually by pushing buttons on the panel. The hydrogen zeolite softeners are not provided with automatic controls; hence, the instrument panel is located near them to permit one operator to supervise the entire plant. Without automatic controls, probably three operators would be needed per shift due to the three-level layout.

The third, or manual, procedure is more of an emergency method. When any of the equipment must be taken out of service, the necessary valves can be closed or opened manually and there will be no chance of accidentally opening a valve from the panelboard.

Instrumentation

Because of close quarters the instrument panelboard is greatly condensed. Across the top of the panel are six flow recorders with Minneapolis-Honeywell electronic integrators. These are electrically connected to meter bodies measuring the flow of softened water to each of the six mixed beds. Lights below each of the flow meters indicate when a bed is exhausted, when it is under automatic control, and whether it is on standby or in service.



METER bodies electrically connected to—

*Developed and manufactured by Illinois Water Treatment Co.

A CENTRALIZED instrument panel handy to the sample table.

An ElectroniK potentiometer records and indicates the pH of the treated water. It is equipped with an alarm switch, which actuates a red light to warn of low pH. All the alarm lights are in the middle of the panel.

A strip chart recorder below the signal lights and pushbuttons alternately records the conductivity of the effluent from each of the six beds. Two alarm switches sound a horn and light a signal under the flow recorder for a mixed bed when that bed nears exhaustion. The conductivity end point is then supplemented by silica determinations.

Other instruments record and control the flow of regenerants and rinse water. A temperature controller under No. 5 flow recorder pneumatically positions a steam valve on the caustic regenerant line. It was found necessary to heat the caustic solution for greatest efficiency, and this is done by steam injection. A non-indicating on-off temperature controller mounted behind the panel serves as a high temperature cut-off and actuates a second valve to shut off the steam at the excessive temperatures that would result from failure of the first system. This high-limit safety control insures the ion exchange resins against damage from overheating.

A ratio flow controller measures the flow of water and controls the flow of 50 per cent caustic solution to maintain the predetermined concentration to the mixed bed. The steps of the regeneration cycle are indicated by lights below the red alarm lights. They include the following:

1. Start regeneration
2. Drain
3. Backwash
4. Settle
5. Regenerate
6. Drain
7. Agitate with air
8. Fill and vent air
9. Settle
10. Rinse

After regeneration is completed, a unit is either automatically returned to service or held in standby.

Regeneration Cycle

Regeneration takes about four hours and consumes about one per cent of the treated water produced on a run. While the quantities of regenerant chemicals are presently excessive, they will eventually be reduced as much as 30 per cent. Currently the costs of regeneration are about $7.00 per 1,000,000 pounds of water or $0.0583 per 1,000 gallons. The Illco-Way design permits both acid and caustic regeneration simultaneously. This is a big factor in saving time.

If the regeneration steps are started manually from the board instead of automatically, they must be taken in sequence; pressing the button for any particular step automatically cancels the preceding steps. Also, no more than one bed can be regenerated at a time. A non-indicating conductivity measuring device determines the end point of regeneration.

Water for regeneration is required at three different rates. This is achieved by means of a single controller in a unique hook-up. One flow recorder is equipped with a Fixed Indexet mechanism by which it is possible to change the control index setting of the recorder by changing the air pressure on the bellows. The 150 per cent proportional band control unit, also included in the instrument, positions a diaphragm motor valve controlling the flow of dilution water to both the acid and caustic regenerant systems. Three parallel air lines are connected to the Indexet mechanism. Each is equipped with a pressure regulator followed by a three-way motorized valve.

Each valve either bleeds air to the atmosphere or applies the air pressure in its line to the mechanism. The three regulators are set to obtain the desired pressures on the Indexet unit, which in turn sets the desired set point on the flow controller. Each valve is energized in turn to sequence the three flow rates. The fastest rate is used for backwashing. A rate at about one-half that for backwashing is used for injection of the regenerants. This rate is applied to the caustic feeding system and measured by the caustic recorder, which in turn regulates the rate of 50 per cent caustic feed.

Acid feeding rates are obtained differently. Dilute acid is pumped to the bed from a tank at a constant rate. Meanwhile, concentrated acid is pumped to the tank—first slowly, then at a faster rate. Dilution water is taken from the line carrying hydrogen zeolite treated water by a float-actuated level control valve. This system obtains the desired results with the minimum of equipment. It represents excellent and clever engineering design, since flow rates and material balances were quite complicated to establish.

The third rate of flow of water for the regenerating cycle is a very slow rate applied for a brief period to vent the bed of air after the mixing step.

Results Are Gratifying

Since the demineralizers have been installed, the silica content of makeup water has been reduced from 1 to 2 ppm to 0.01 ppm and the silica content of the boiler water is being correspondingly reduced. Since the steam condensate system has been high in silica since 1938, it is taking time to eliminate the silica that has accumulated over the intervening years. Nevertheless, it has been possible to reduce continuous blowdown substantially. In addition, since turbine fouling has diminished, cleaning schedules have been lengthened and the situation continues to improve.

W&SW

Treatment of A Strong Carbohydrate and Chromium Waste

An interesting example of successful design by engineering estimation without previous experiments in treating the wastes involved

by GEORGE A. RHAME

Mr. Rhame is Sanitary Engineer of the Division of Water Pollution Control, State Board of Health, Columbia, S. C. This article is adapted from a paper presented at the 9th Purdue Industrial Waste Conference, with additional data to complete the picture.

THE PROBLEM described in this article is an interesting example of the design of a complicated treatment works on the basis of a chemical analysis and engineering estimates without benefit of a pilot plant or of previous experience in treating the wastes. The designing engineers prepared an extensive engineering report on all phases of the problem. Results have proven their estimates to be substantially correct.

Few reliable technical data are available on this plant. Like a majority of industrial and municipal treatment works it may be classified as an uncontrolled experiment due to the lack of technical training of operators and supervisors in waste treatment. Such data as are available are included with this report. They plainly show the effectiveness of the treatment.

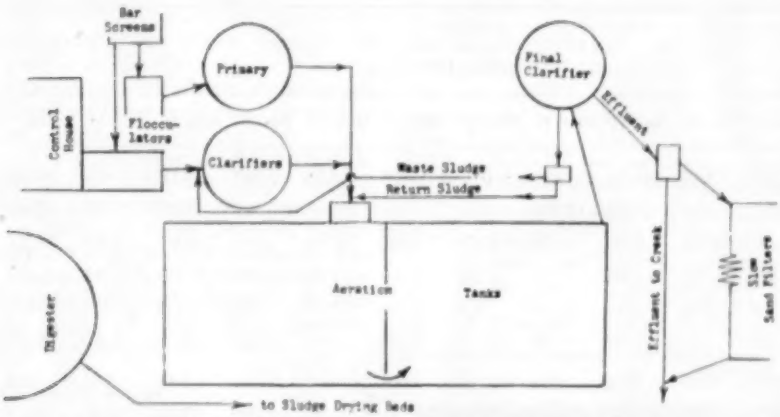
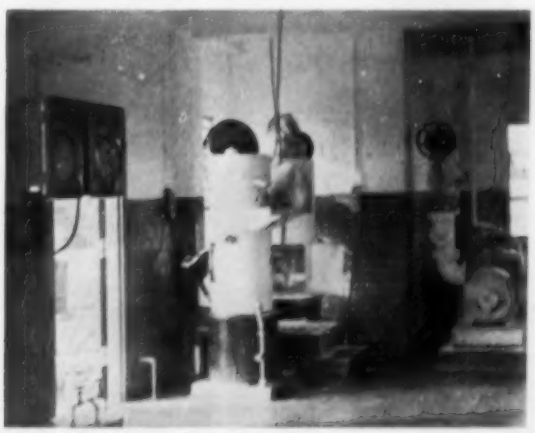


Fig. 1—SCHEMATIC layout of OCF waste treatment plant at Anderson, S. C., treating a strong industrial waste containing carbohydrates (starch) and chromium.

Origin of Wastes

The treatment plant in question is designed to treat waste from a plant of the Owens-Corning-Fiberglas Corporation. The manufacturing process consists essentially of producing the glass fibers, then forming them into a thread in a manner roughly analogous to spinning. During the process a binder is applied to help form the fibers into a thread. It is the wasted part of the binder which is the source of pollution needing correction.

The treatment plant was built shortly after the manufacturing plant



CONTROL HOUSE interior, showing laboratory section (left) and chemical feeder and blower room (right).

began partial operation. In designing the installation the consulting engineers were freely assisted by the Fiberglas Corporation, which furnished quantitative and qualitative data from their plant at Huntington, plus estimation of differences to be expected from the more modern plant at Anderson, S. C.

The wastes for which treatment was provided consisted of the following:

1. Sanitary and cafeteria wastes from three shifts, 200 people per shift. The cafeteria is open during each shift.
2. A predominantly starch waste containing some borax and formaldehyde.
3. A waste containing much starch, but different from the foregoing due to the presence of trivalent chromium as methacrylate chromic chloride in an isopropane-acetone emulsion, more conveniently known as "Volan".

Treatment Plant Design

Because of the high B.O.D. anticipated in the wastes, it was decided to use the activated sludge process assisted by chemical coagulation. Because of the anticipated chromium content of part of the waste, the plant was designed to operate in two sections, as follows:

1. Chemical precipitation, activated sludge, separate sludge digestion and open drying beds for sanitary and starchy wastes.
2. Chemical precipitation and open drying beds for wastes containing chromium.

Further study resulted in the following installation (see Fig. 1 for flow diagram):

(a) For sanitary and starch wastes there were provided bar screen and grit channel, flow meter and recorder, flash mixing for chemical treatment, flocculation tank for chemical treatment, primary settling tank, aeration tanks (activated sludge), final settling tanks (with sludge return), sludge digestion tank and sludge drying beds. Slow sand filters for effluent polishing were added after the original construction.

All units have been designed on a flow basis of 80,000 gpd, of which one-half was expected to be industrial waste under maximum conditions. Anticipated maximum loadings were

TABLE 1

Results of 24-hour Composite Sampling at Fiberglas Waste Treatment Plant, Anderson, S. C.

Sampling Point	Determination	Date, 1953											
		Nov. 5	Nov. 8	Nov. 9	Nov. 10	Nov. 11	Nov. 12	Nov. 15	Nov. 16	Nov. 17	Nov. 18	Nov. 19	Ave.
Raw waste	BOD, ppm	1197	1120	1736	1408	975	858	1948	1450	1742	1878	1468	1435
	COD, ppm	2980	2640	—	3020	2180	1600	—	—	2780	3080	2380	2580
	pH	6.53	6.33	6.78	6.90	6.28	6.57	6.03	6.83	6.70	6.64	7.08	6.61
	M.O. alk., ppm	20	16	21	46	13	24	14	26	28	29	43	26
	Chromium, ppm	—	—	—	—	—	3.9	—	—	5.8	11.3	5.0	6.5
	Kjeldahl N, ppm	—	2.50	—	3.00	2.50	30.00	12.00	—	0.22	0.70	6.50	9.28
Primary effl.	BOD, ppm	698	620	834	926	685	1038	1218	730	1202	836	848	876
	COD, ppm	1464	1455	—	1830	1075	1765	—	—	1795	1515	1560	1557
	pH	7.69	7.53	7.54	6.87	7.04	7.02	7.78	6.81	7.26	7.44	7.19	7.29
	M.O. alk., ppm	71	70	51	40	49	39	68	49	42	47	41	52
Final effl.	BOD, ppm	—	3.2	11.5	3.5	4.8	5.3	28.0[b]	31.0[b]	25.5[b]	25.0[b]	16.5[b]	15.4
	COD, ppm	102	99	—	110	116	100	—	—	173	172	181	117
	pH	7.73	7.62	7.96	7.43	7.43	7.34	7.65	7.68	7.60	7.47	7.53	7.59
	M.O. alk., ppm	86	82	—	83	82	79	92	95	98	94	92	88
	Trans., %	94.4	93.0	—	—	92.8	94.2	94.9	90.0	—	—	—	—
	Chromium, ppm	—	—	—	0.08	—	—	—	—	0.14	—	0.15	0.12
	NH_3—N, ppm	—	0.15	—	0.26	2.00	0.32	0.40	—	0.28	0.24	0.24	0.49
	NO_2—N, ppm	—	0.0005	—	0.00	0.0035	0.0001	0.0030	Tr	0.0040	0.3000	0.5000	0.0900
	NO_3—N, ppm	—	—	—	2.20	—	0.28	0.24	0.24	0.16	0.50	3.20	0.97
Outfall[a]	BOD, ppm	3.8	64.6	18.5	6.0	7.5	5.0	20.5[b]	11.0[b]	10.5[b]	32.5[b]	19.0[b]	18.1
	pH	7.81	7.63	7.82	7.53	7.83	7.53	7.88	7.77	7.65	7.65	7.62	7.70
	M.O. alk., ppm	63	66	—	80	77	73	94	88	87	79	80	79

[a]At creek; contains some surface drainage. [b]Seeded with settled Anderson sewage.

2,700 pounds of dry solids and 18,000 pounds of 5-day BOD at 2,700 ppm.

Design factors were:

Flash mixing	19 min
Flocculation	53 min
Primary settling	3 hr
Aeration tank, without recirculation	62 hr
Aeration tank, with recirculation	42 hr
Final settling	3 hr
Maximum sludge return	25%
Blower capacity	540, 780 and 1070 cfm

(b) For wastes containing chromium mixing, flocculation and settling tanks were provided of the same sizes as for other wastes, with an expected maximum flow of 40,000 gpd and retention periods in proportion.

Plant Units

All clarifiers are of the Spiraflow type, air is diffused by six swing diffusers, compressors are "Standard-aire." All flash mixing, flocculation, and return sludge lifts are operated by compressed air. Flow through the plant is by gravity, except for the return sludge and effluent recirculation. Clarifier sludge is moved by centrifugal pumps.

The sludge digester has a capacity of 31,800 cubic feet, with floating cover and external heat exchanger. Six drying beds are provided for digested sludge, each 20 feet by 80 feet, for a total area of 9,600 square feet. Sixteen beds, each 10 feet by 20 feet, for a total of 3,200 square feet, are provided for chrome sludge.

Operating Results

The chrome was treated with ferrous sulfate and lime, producing a clear effluent with a very low chromium content. Operation was soon complicated, however, by treatment of air conditioning water with a dichromate corrosion control. Blowdown was added to the Volan waste, greatly increasing the difficulty and cost of this treatment. After some months the corrosion control was changed over to a non-toxic compound.

It was soon noticed that the clear effluent from the Volan waste treatment had a considerable content of soluble starch, which was very bad for the over-all plant effluent. With some juggling of controls this was added to the waste receiving activated sludge treatment. Somewhat later, separate treatment of Volan waste was discontinued, all waste except air-conditioning blowdown being sent to the activated sludge units. This

TABLE 2

Results of Grab Samples from Betsy Creek Below Fiberglas Outfall

Date, 1953	Discharge, cfs	Temp., °C.	D.O., ppm	% Sat.	BOD, ppm	Pop. Equiv.	pH	M.O. Alk., ppm
Nov. 16	0.4	14.0	6.50	....	5.3	67	7.33	59
Nov. 17	0.3	14.5	5.40	....	5.6	53	7.32	64
Nov. 18	0.3	15.0	5.95	....	8.5	81	7.38	56
Nov. 19	0.4	14.5	3.75	....	39.4	500	7.40	95
Nov. 20	0.4	16.0	4.40	....	15.0	190	7.35	72
Average:								
Nov. 1953	0.36	14.8	5.20	....	14.8	178	7.36	69
Feb. 1953	1.03	11.8	7.90	72	24.9	1023	6.87	25

[a] Waste flow = 0.14 cfs.

TABLE 3

Summary of Analytical Results at Fiberglas Waste Treatment Plant, Anderson, S. C.

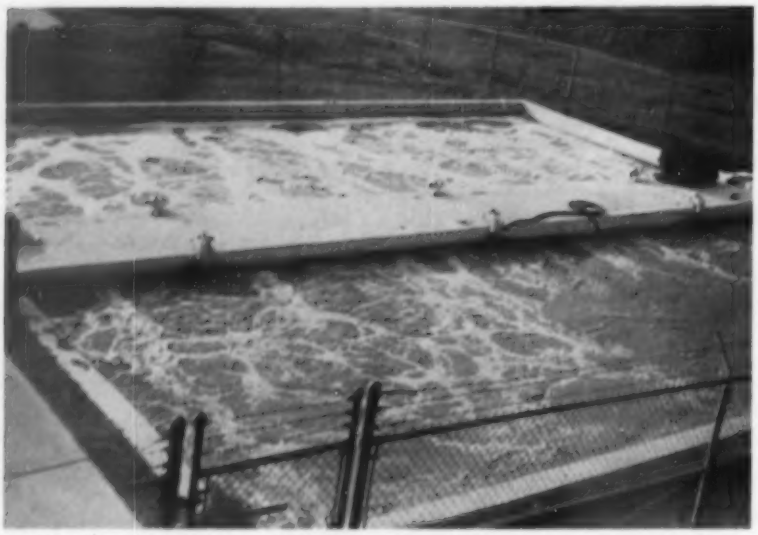
Sampling Point	DO, ppm	BOD[a], ppm	COD[b], ppm	pH	M.O. Alk., ppm	% Trans.	Ch., ppm	Nitrogen, ppm: Kjeldahl	NH_3	NO_2	NO_3
Raw waste	....	1435	2583	6.61	26	.....	6.50	9.28	6.5	.....	.....
Primary effl.	....	876	1557	7.29	52	.....	.....	.....	.....	.....	.....
Final effl.	....	15.4	117	7.59	88	92.0	0.12	.....	0.49	0.09	0.97
Outfall pipe	....	18.1	.....	7.70	79	.....	.....	.....	.....	.....	.....
Betsy Creek	5.2	14.6	.....	7.36	69	.....	.....	.....	.....	.....	.....

[a] BOD removal: Primary = 39%; secondary = 98%; overall = 99%

[b] Comparison of BOD/COD ratio on days both available:

Sample	BOD	COD	Ratio	
Raw waste	1331	2583	51.5%	
Pri. effl.	857	1557	50.4%	
Final effl.	4.2	106	4%	(not seeded)
	22.3	175	13%	(seeded)

FINAL tank (left) and primary tank (right) are small units (80,000 gpd design basis). Rapid sand filters for effluent polishing are in background.



AERATION tanks handle all wastes after the chromium waste has been pretreated.

system eventually worked very well and is still in use.

The activated sludge plant, including the alum and lime precipitation, started up in good order and continued so for a few months. Then it collapsed and operated at relatively low efficiency for a number of months. Causes of this condition are obscure, but appear to be connected with inadequate feeding, a change in the character of the digester supernatant, variable dissolved oxygen in the aeration tanks, and the reluctance of shift operators to waste activated sludge because it spoiled the looks of the primary clarifier. It also was found that consumption of Boraxo in hand washing in the manufacturing plant was sufficient to give about 20 ppm in the effluent. The management agreed to change to another type of soap.

Several expedients were tried, including high and low aeration tank dissolved oxygen and much increased return sludge rates (an additional air lift was installed which would give over 100 percent return). The volume of sludge by the 30-minute settling test was always high. During this period the chrome size waste was mixed with the rest before treatment. Later it was determined that return sludge rates should have been reduced, rather than increased. Therefore, sludge return was cut to a minimum, aeration tank DO was stabilized at 2 to 4 ppm, and soon afterwards the plant again attained a high efficiency.

Technical data accumulated by the treatment plant operators are generally unreliable, although adequate for plant control. At present the principal control factor is aeration tank suspended solids. Sludge is wasted only when suspended solids exceed 2000 ppm, as determined by centrifuging, decanting the tubes, and weighing the residue. The percentage of waste on a monthly basis is very low. The sludge volume index varies widely.

Flow measurements have been of little value as the peak rates grossly exceeded the meter capacities. Present flows, excluding air conditioning wastes, are estimated to be in the neighborhood of 100,000 gallons per day. On the basis of analyses made by the laboratory of the South Carolina Water Pollution Control Authority, gross loading is 1200 pounds BOD; load to aeration, 730 pounds BOD; load to creek, 13 pounds BOD.

The range of daily consumption of chemicals is as follows:

Alum	300 to 600 lbs
Lime	300 to 600 lbs
Nitrate fertilizer	20 to 95 lbs
Phosphate fertilizer	10 to 50 lbs.

During the sampling period, Fiberglas data show the sludge volume index to have been in first pass about 2 ppm, in the second pass 5 ppm, in the effluent 4.5 ppm. Detailed analyses are shown in Tables 1 and 2. These data are summarized in Table 3. Note the BOD/COD ratio.

Data obtained by Fiberglas personnel during a period of exceptionally clear effluent are shown in Table 4.

General results have been quite satisfactory since the plant operation has been stabilized, except when a large quantity of sizing is dumped by accident. This has been partially alleviated by diverting such shock loads to the idle clarifier. Goldfish lived in the final clarifier for some months until the treatment plant was upset by a spill. Recovery took about a week.

Digestion has not conformed to the usual standards, the sludge generally having pH 6 or less. Fertilizer and lime have been added regularly for some months. The sludge dries readily enough, with little odor unless rained on when drying is nearly complete.

The sand filters have been of little use. They are really needed only when sludge is going over the effluent weir. At such times they clog very rapidly. Effluent recirculation also has been found to be of little value.

SLUDGE drying beds divided into very small units provide exceptional flexibility of digester operation.

Summary and Conclusions

The treatment plant described here is an interesting example of successful design by engineering estimation without previous experiments in treating the waste involved. Performance is now relatively rugged and dependable as long as close watch is kept on the pH of the primary effluent, the dissolved oxygen in the aeration tanks, and appearance of slugs of concentrated waste resulting from spills in the manufacturing process.

Cooperation between the mill people (including plant operators), the designing engineers and the South Carolina Water Pollution Control Authority has been excellent. The treatment plant was designed by Paul A. Uhlmann and Associates of Columbus, Ohio.

W&SW

TABLE 4
Fiberglas Data at Period of Very Clear Effluent
(Analyses by Ken Bowling, Operator)

Date	Average DO, Aeration Tanks, ppm	Susp. Solids, ppm	Solids, 30-Min. Settling, ml/l	Sludge Vol. Index	Effluent BOD, ppm
July 1, 1953	3.6	1166	260	223	14.3
July 2, 1953	3.8	1333	240	180	.....
July 3, 1953	3.6	1250	225	180	26.7
July 4, 1953	3.5	1083	190	175	.....
July 5, 1953	3.2	1250	210	168	18.6
July 6, 1953	3.8	1250	230	184	.....
July 7, 1953	4.1	1333	260	195	21.2
July 8, 1953	3.9	1416	250	177	.....
July 9, 1953	4.3	1416	280	198	24.4
July 10, 1953	3.8	1250	230	184	.....
July 11, 1953	3.5	1333	200	150	31.6
July 12, 1953	3.0	1250	180	144	.....
July 13, 1953	3.1	1083	210	194	.....
July 14, 1953	3.4	1250	200	160	8.4
Average	3.6	1262	226	179	20.7

Major Messer, Pioneering State Sanitary Engr., Retires

Richard Messer, long-time director of the engineering division, Virginia State Dept. of Health, and a pioneer state sanitary engineer who came to Virginia in 1910, retired on August 1st after 45 years of effective public service.

"The Major," as he is known to many because of holding that rank in World War I, is a native of Claremont, N. H., and a graduate of Thayer School of Engineering, Dartmouth College. He is in his 74th year. In 1910 he was brought to Virginia as the State Board of Health's first and only sanitary engineer. He retires as director of one of the Department's major divisions. If not the oldest living state sanitary engineer, he is second oldest, possibly being topped in seniority only by Victor Ehlers, Chief of the Texas Dept. of Health's sanitary engineering division.

Messer has much to his credit in the way of procuring safe water supplies and sewage treatment in Virginia. On leave of absence during World War I, he served as major in the Construction Div., U. S. Engineers, in charge of water supplies and sewage treatment for camps and army posts in the U. S. A. He organized the Virginia Water & Sewage Works Association which was taken over by the Am. Water Works Ass'n as the Virginia Section. Later he was instrumental in organizing the first combination sewage and industrial wastes association, which established a precedent wherein industrial pollution actually out-ranked domestic pollution. A long-time member of all principle technical associations and societies in the field of public health and sanitary engineering, his membership in AWWA dates back to 1911. He is a Life Member, served as Director from the Virginia Section and is a Fuller Awarder.

Major Messer is being succeeded by Eugene ("Gene") C. Meredith, as director of the Virginia Sanitary Engineering Div. Meredith, a native Virginian, steps up from the assistant directorship. He is 48 years old and a graduate of Virginia Polytechnic Institute, with degrees of B.S. and M.S. in civil engineering. He is a member of AWWA and only recently was elected as the Virginia Section's representative on the National Board of Directors. So, "The Major" can now retire, realizing that he sees his office turned over to highly competent hands in the person of "Gene" Meredith.

HANK: Sure is a blowin' rain, ain't it?
TOM: Yea, and y'know it smells a powerful lot like our shower at home has lately.

STORM SEWER RESTORATION *operation interferes only slightly with heavy traffic in street as concrete is pumped through manhole to*

Air Placed Concrete Repairs

by RALPH CRONEMEYER, President
Air Placement Equipment Company
Kansas City, Missouri

A SERIOUS and costly problem faced the city of Leavenworth, Kansas, when it was discovered that 2400 feet of storm sewer under one of the busiest city streets was in danger of failing completely.

The sewer, which was constructed during the Civil War when Leavenworth was a hub of military activity, had become badly deteriorated. Originally constructed of rock and mortar, the arch sewer is 5 feet wide at the base and 40 inches deep at the crown.

Many years of use had taken their toll. The mortar began falling out, and large sections had spalled badly. In addition, the brick floor had washed out and in many places a 12-inch sanitary sewer which runs the length of the sewer had become exposed and broken.

Twofold Problem

The problem facing the Leavenworth Sewer Department was twofold. First, it was necessary to find a means of repairing the damage without having to excavate. The sewer is from 12 to 35 feet below grade and runs under one of the busiest streets in Leavenworth. Aside from the costs involved in tearing up any section of the street, there would still be the problem of getting men and materials down into very tight working areas within the sewer.

The second problem was one of cost. To attempt to point up the spalled rocks and repair the floor using normal methods would have made costs prohibitive, as the engineer's original estimate clearly indicated.

The entire project consisted of pointing up joints and voids between the old rocks in the main sewer—in some places to a depth of 15 inches—with concrete, putting in a new concrete floor, and repairing the sanitary sewer where it had become broken.

The problem of how to do the work was quickly overcome. A new method of concrete restoration and repair was to be employed. Many factors led to the decision to use air placed concrete. The only available access to the sewer was a series of manholes which were from 150 to 250 feet apart. This would allow running the hoses of the concrete gunning equipment down through the

TWO-MAN PLACEMENT CREW working in badly deteriorated masonry arch conduit with washed-out floor and broken sanitary line

90-year-old Leavenworth Sewer

manholes and into the work areas.

In addition, the type of concrete gunning equipment had to be carefully considered. It would have to be of a type that could operate efficiently with a long material placement hose—over 250 feet of hose were finally used—and a machine that would operate under reduced pressure so that the gunned concrete would not rebound off of the wall. This latter point was important because in most cases men would be working in an area only 5 feet wide and 40 inches deep. The equipment selected was a Model 1250 Bondactor*, used with an air compressor delivering 210 cfm.

The first step in the operation was to sandblast the walls and arch of the sewer, removing any loose material and insuring a better bond when concrete was gunned into the joints. For this phase of the operation, the same equipment was used, employing dry sand as the cleaning agent.

After the joints had been cleaned out, concrete was gunned into the joints. In some areas the walls were smooth enough so that the concrete formed a complete lining for the walls. The machine itself was located above ground, where the aggregate was mixed and placed in the machine. The concrete was then metered out and forced down through a 1½-inch placement hose—through the manholes—for application by nozzlemen working underground. A small generator provided current for a floodlight used to light the area in which work was being done.

After the walls had been repaired, concrete was gunned over a heavy-gauge wire mesh that had been laid along the floor. This new reinforced floor served as additional support for the sewer arch and to strengthen the sanitary sewer.

A three-man crew was all that was necessary to operate the concrete placement equipment. One man worked above ground and operated the controls on the machine itself, while two men worked as nozzlemen down in the sewer.

Thanks to the modern methods used on this job, it was possible to complete the restoration project for less than one-half of the engineer's original estimate.

The George P. Reintjes Company, of Kansas City, Missouri, were the contractors on the job.

* A product of the Air Placement Equipment Company, Kansas City, Mo.

REPORT FROM ABROAD

1955 ISP Conference Report

Part I—Brighton meeting draws record registration

by John Finch

Mr. Finch is manager of the Sewage Disposal Department, Rotherham, England. In his reports from abroad he discusses topics and opinions of timely interest. He welcomes the opportunity of replying personally to readers desiring additional information regarding subjects covered in his series.

WHAT is understood to be the largest number of delegates ever to attend a conference of the Institute of Sewage Purification made the 1955 event a record one. There were many delegates from overseas, covering a wide range of countries. The conference was held June 13-17 at Brighton, England.

The technical sessions included an abundance of very good material, both on the Conference agenda and in the discussions of the papers. A common factor in all the technical contributions was the general comment on industrial effluents and their influence on sewage treatment processes.

The new President of the Institute, Mr. Harold Taylor of the Stalybridge and Dukinfield Joint Sewerage Board, stated in his inaugural address that the purification of domestic sewage is not today a very difficult problem, but that the difficulties almost all arose from the uncontrolled discharge of trade effluents to the sewers. He went on, however, to say that with few exceptions there can be no doubt that industrial effluents are best treated along with sewage, where this can be carried out, both as far as economics and river pollution prevention are concerned.

Speaking of the production of power from gas produced by heated sludge digestion processes, the President observed that publication of sound cost figures for medium-sized sewage plants would be welcomed, for although it may seem wasteful to let sources of potential power remain unused, it was hardly in the best interests of local authorities that ideals be allowed to run ahead of economic facts. There is obvious scope for reliable data on power production from sludge gas for towns of, say, 30,000, 50,000, 100,000, and over 100,000 persons, particularly if financial balance sheets are included.

Visit to Crawley Plant

The visit to the Crawley sewage treatment plant was well attended. This plant is one of the new postwar installations put into operation in 1951 and incorporating the diffused air activated sludge process.

All the new housing development in the new-town area is drained on the separate system of sewerage, but parts of the old town in Crawley and Three Bridges are sewered on a combined system.

The treatment plant has been designed to deal with a dry weather flow of 45 gpcd plus an allowance of 20 gpcd for trade discharges. The sewers have been designed to carry a maximum flow equivalent to four times the dry weather flow domestic sewage plus two times the trade flow, making a total of 220 gpcd. All of this flow passes through the sewage treatment plant and receives full treatment.

Design of the treatment plant was such as to allow of it being constructed to suit the development of the town. The first stage, put into operation in September 1951, was for a population of 10,000 persons. The next stage, put into operation in 1954, brought the capacity up to 30,000 population. A further stage to bring the total capacity to 50,000 population is to be commenced in the near future. The ultimate size of the town is intended to be about 60,000.

Final effluent from the Crawley plant discharges to the Gatwick stream, a waterway coming under the control of the Thames Conservancy. During the summer the total effluent from the sewage treatment plant when the town is fully developed, will be more than the flow in the stream. Therefore, the Thames Conservancy have asked that the standard of effluent discharged shall be no more than 10 ppm BOD and 20 ppm suspended solids. In the event that it is not possible to attain this standard, space has been reserved on the site to install micro-strainers to give additional treatment to the effluent.

The plant comprises screens, grit tanks, primary settling tanks, activated sludge plant, final settling tanks, and heated sludge digestion. Power production from the sludge gas is included in the scheme.

Self-Purification in Harbors

In a paper entitled "The Self Purification of Sewage and Sewage Effluents in Harbor Waters," Ronald Hicks, Chief Chemist, Auckland Metropolitan Drainage Board, New Zealand, and one-time Manager of the Hamilton (Scotland) sewage treatment plant, said that the primary factors involved in the choice of outfall and in determining the degree of treatment to be afforded sewage prior to discharge are aesthetics, public health aspects, and receiving water usage. At all times economics were an important factor. Although aesthetic considerations must apply at all times, the outfall itself should be both out of sight and free from smell, or the sewage should be pre-treated so that to a reasonable degree evidence of such an outfall is nonexistent. Bacterial counts, although having some signifi-

cance, cannot replace an adequate sanitary survey. In the absence of conclusive evidence of water movement and until more conclusive evidence as to the death rate of all pathogens likely to be contained in the sewage is available, sterilization should be employed if re-siting of the outfall is impractical. Where shellfish cultivation is carried out in areas known to be exposed to the risk of bacterial contamination, legislation should be enforced to insist upon sterilization of the shellfish before sale.

In all other cases, the communal use of the receiving waters should be the main guide in the assessment of the quality to be preserved. It would seem logical to take full advantage of the process of "self-purification" available by natural means, and to ignore prejudice in all cases where it is of economic advantage to employ harbor and seacoast outfalls.

Mr. Hicks finally stated that the proposed scheme for Auckland would make use of primary setting, high-rate filters and oxidation ponds before discharge to sea.

Tunbridge Northern Plant Visit

The inspection trip to the Northern sewage treatment plant of the Royal Borough of Tunbridge attracted many delegates because of the several interesting features of this installation.

The Northern plant, draining the northern watershed of the Borough, was designed to deal with a dry weather flow of 1,050,000 gpd. Prior to the construction of this plant, the sewage was treated by broad irrigation.

One of the interesting features of this plant is the provision for recirculation or double filtration, as required or desired. This makes for a very flexible operating program.

The plant comprises screens, grit channels, primary settling tanks, high- and low-level percolating filters, storm water tanks, humus tanks constructed in pairs behind both the high- and low-level filters, and sludge drying beds.

Interesting structural features include prestressed reinforced concrete bridges carrying the sludge scraper mechanisms in the humus tanks (Fig. 2), and the installation of semi-buoyant continuous arm scraper mechanisms in the humus tanks, making for a very simple form of construction. The sludge scraping mechanism in the storm water tanks is of very simple form for what is in fact a very dense type of sludge.

Luton Developments

A paper on "Recent Developments in Sewage Treatment at Luton," by S. G. Evans and F. W. Roberts, inspired much interest and discussion, particularly with respect to the effect of effluent improvement on the condition of the River Lee, into which the Luton plant discharges (see W&SW, p. 128, March 1953). In this case treatment was complicated by the inclusion of industrial wastes and by the fact that the Luton effluent diluted the receiving stream.

However, today the Luton effluent can be claimed to be superior to that from any industrial community in the country, as a result of improvements which have been made and which have included micro-strainers and sand filters, and additional capacity in the aeration tank, along with an increase in the air supply to the aeration plant.

Micro-strainer plant costs £580 per annum (capital and operating costs) per mgd unit; the sand filters cost £737 per mgd unit.

Referring to the effect of synthetic detergents on streams, the authors say that many sewages now contain upward of 3 ppm of detergent residues, resistant to biological oxidation, and that these residues, even when well diluted, may be expected to have a marked effect in reducing the rate of solution of oxygen and the capacity of a stream for self-purification. Much attention has been given in the past few years to the deterioration in the quality of sewage effluents influenced by synthetic detergents, and that it may be possible to counter such an effect by the extension or the addition of treatment processes at the sewage treatment plant. However, even after this is achieved it would appear that a residue will be left in the effluent capable of interfering with the re-oxygenation process to a marked degree, and also having other properties capable of interfering with the ecology of the streams. This must rank as one of the most important problems requiring solution.

(*To be continued*)

Fig. 1—SYPHONIC sludge withdrawal from final settling tank following activated sludge process at Crawley New Town sewage treatment plant

Fig. 2—PRE-STRESSED concrete mechanism bridge on humus tank at Northern sewage treatment plant of Royal Borough of Tunbridge.

THE EDITOR'S COMMENTS

AWWA Fluoridation Policy Stands Test of Time

Now, for the fourth time, AWWA's Water Fluoridation Policy, adopted in 1949, has stood the test of time. It was again brought up for review and was again reaffirmed by the association's Board at the Chicago convention on June 12, 1955.

The vote of the Board to reaffirm the original fluoridation policy statement adopted at the previous Chicago convention of 1949, with the amplifying statement of 1951 at the Miami convention, was *unanimous*. This we think was the most impressive part of the action, when considering the fact that the predominating make-up of the Board represents water utility management. Significantly, the fourth vote reaffirming the policy statement came after a decade of controlled water fluoridation, the results from which have confirmed the soundness of the studiously evolved policy statement.

The "Fluoridation Policy Statement" of AWWA, as adopted by the 1949 Board, and now amplified or reaffirmed by three subsequent Boards, is as follows:

"In communities where a strong public demand has developed and the procedure has the full approval of the local medical and dental societies, the local and state health authorities and others responsible for the communal health—water departments or water companies may properly participate in a program of fluoridation of public water supplies."

"Recommendations for fluoridation are prerogatives of the dental, medical and public health groups. When the proper authorities approve the treatment, it then becomes the function of the water works utility and industry to follow through willingly and intelligently where proper controls are assured."

The first paragraph is the original (1949) policy statement. The second paragraph is the amplifying statement of 1951.

It is to be noted that in no respect can AWWA's policy statement be interpreted as promoting, endorsing or even "approving" water fluoridation. The matter of approval of fluoride enrichment of public water supply is left to dental, medical and public health authorities. However, once the decision to fluoridate is made by such authorities it properly "becomes the function of the water works man to follow through *willingly* and intelligently when proper controls are assured."

Objection to the addition of still another chemical to water seems to be a matter of history repeating itself. This much was brought out in a statement made during the discussion by the Board. The comments, which follow, were more familiar to the older members of the Board than to the younger members. It was recalled that:

When coagulation of raw waters with alum was introduced as an element in rapid sand filtration, it was opposed in some quarters on the theory that the use of coagulants might have long term adverse effects upon the users of such chemically treated public water supplies. History has demonstrated the reverse to be the case.

When chlorination was first advocated as an additional element in the improvement of drinking waters from a public health standpoint, it was opposed by certain very prominent individuals. History has demonstrated that chlorination of water has been of great value to the water consuming public and has had no adverse long time effects upon persons using the water.

The writer takes particular pleasure in the unanimous vote of the 1955 AWWA Board in reaffirming the original Fluoridation Policy Statement of the association because of the fact that he served on the special committee that developed the original statement of policy on this then (1949) highly controversial matter.

Were There More Wisconsins

To our thinking one of the highlights of the recent AWWA convention program was the paper presented by Orville P. Deuel, of the Wisconsin Public Service Commission, in which was recounted some of the viewpoints of the Commission in the matter of regulating publicly-owned water systems, as well as those privately owned.

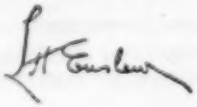
In Wisconsin *all* water utilities are regulated by the Public Service Commission. Managers of the publicly owned systems have long since learned of the value of such regulation—particularly in the matter of adequate water rates and fair payment by the cities to the publicly owned water utility for fire protection facilities; and, proper return on investments in main extensions.

In the matter of main extensions—the principle topic up for discussion—it was learned that the Commission rule is that a main extension is unsound practice financially unless the annual income from such extension is 25% of the overall cost of making the extension. Mr. Deuel stated it slightly differently, saying that sound practice calls for a limit of expenditure for a main extension which is four times the assured annual revenue from customers served by the extension.

This statement was of particular interest because of the fact that privately owned water utilities long ago reached the same conclusion regarding the permissive expenditure for main extensions. What's more, all publicly owned water system managers who have calculated the costs of main extensions realistically have come up with essentially the same figure—none less than 20%.

One disclosure of interest to many is the fact that the Wisconsin Commission, by state law, permits combination financing of water and sewerage facilities, as well as combination operation of those two interlocking services. In reply to a floor question, it was stated that surplus income from water supply operation could be used in the construction or operation of sewerage systems.

As so often remarked by this writer: Had we only more Wisconsins with its beneficially regulatory Public Service Commission extended to include publicly owned water utilities. Maine is a close runner-up in the matter of beneficial regulation of publicly owned water utilities by its helpful Maine Public Utilities Commission. With respect to the value of such regulation, in neither state have we ever heard anything but good from the management side of publicly owned water systems.



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*Exclusive of sludge storage volume that may be required by subsequent disposal methods.

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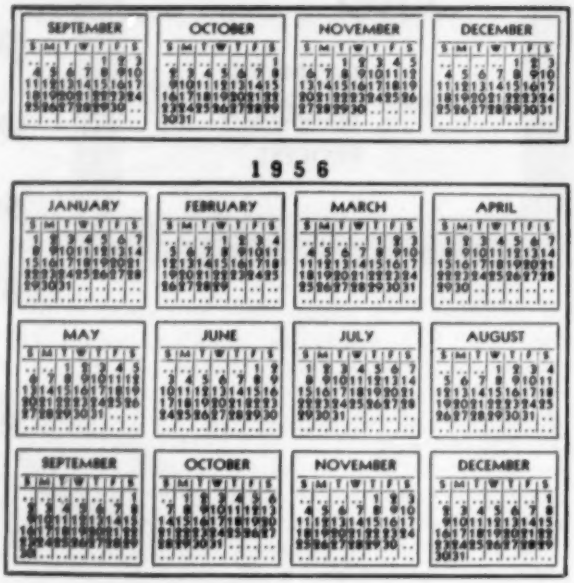


Sept. 7-9—Saranac, N. Y. *(Saranac Inn)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Sept. 7-9—Fort Dodge, Ia. *(Hotel Waukonsa)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Ia.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, S. Leary Jones, 420 Sixth Ave., Nashville, Tenn.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 553 S. Limestone St., Lexington, Ky.

Sept. 14-16—Flint, Mich. *(Durant Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, State Dept. of Health, Lansing, Mich.

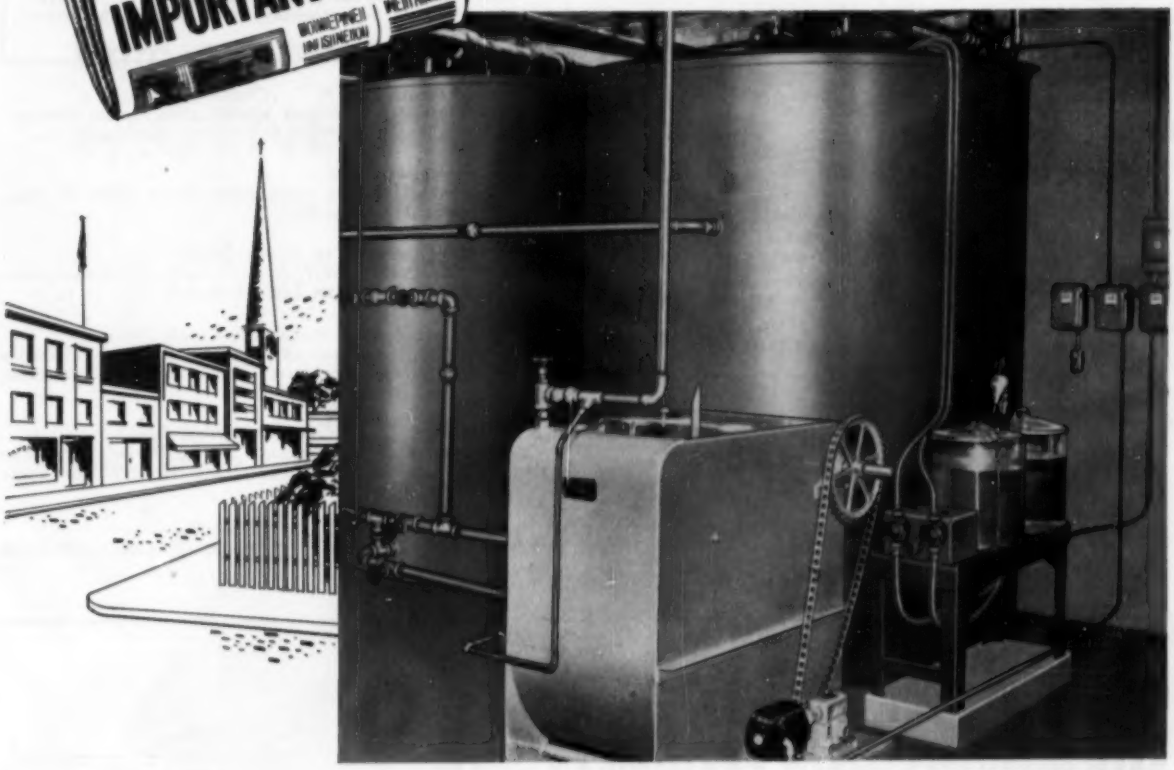
Sept. 18-22—Lake Placid, N. Y. *(Lake Placid Club)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. KNOX, 204 Tremont Bldg., Boston, Mass.

Sept. 19-21—Laramie, Wyo., *(Connor Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, J. W. Davis, Johns-Manville Sales, Inc., Denver, Colo.

Sept. 21-23—Atlanta, Ga., *(Hightown Textile Bldg., Georgia Institute of Technology)*
24th ANNUAL GEORGIA WATER & SEWAGE SCHOOL, Secy. Treas., 1210 Hemphill Ave., N. W. Atlanta, Ga.

(Continued on page 110A)

for Small Communities



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OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, O.

Sept. 21-23—Milwaukee, Wis. *(Hotel Schroeder)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison, Wis.

Sept. 22-24 — Winnipeg, Manitoba, Canada *(Royal Alexandra Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, W. J. Waddell, 3610 Manchester Road, Calgary, Alberta.

Sept. 25-27—Joplin, Mo., *(Connor Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, W. A. Kramer, Rm. 3, 6th Floor State Office Bldg., Jefferson City, Mo.

Sept. 28-30—Williston, North Dakota *(Plainsman Hotel)*
NORTH DAKOTA WATER & SEWAGE WORKS (27th Annual Convention), Peter Nesheim, Supt., City Water Works, Williston, N. D.

Oct. 3-7—State College, Pa. *(State College)*
WATER WORKS SCHOOL, R. R. Kountz, Ass't Prof. San. Engr., State College, Pa.

Oct. 4-5—Springfield, Ill. *(Place not selected)*
ILLINOIS WATER PLANT OPERATORS CONFERENCE, ANNUAL MEETING. Clarence W. Klassen, Chief San. Engr., State Dept. Public Health, Springfield, Ill.,

Oct. 5-7—Minneapolis, Minn. *(Radisson Hotel)*
NORTH CENTRAL SECTION A.W.W.A., Secy. Leonard N. Thompson, Gen. Mgr., Water Dept., St. Paul 2, Minn.

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (Annual Meeting). Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

(joint meeting with)

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, M. S. Kachorsky, P. O. Box 766, Manville, N. J.

Oct. 11-14—Atlantic City, N. J., *(Chalfont Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION (Annual Meeting) Sec'y, Davis Dunlap, 2609 N. Second St., Harrisburg, Pa.

Oct. 12—Norridgewock, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 16-19—San Antonio, Tex. *(Gunter Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

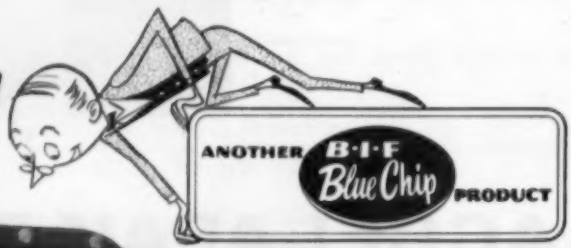
Oct. 17-18—Sydney, Nova Scotia *(Isle Royale Hotel)*
MARITIME BRANCH, CANADIAN SECTION A.W.W.A., J. Douglas Kline, P. Eng. Chief Engineer, Public Service Commission, P. O. Box 608, Halifax, N. S.

Oct. 17-19—Pittsburgh, Pa., *(Hotel William Penn)*
16th ANNUAL WATER CONFERENCE, W. M. Porter, Sec'y., The Engineers Society of Western Pensylvania, Hotel William Penn, Pittsburgh 30, Pa.

Oct. 19-20—Clarksburg, W. Vir. *(Waldo Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION

(Continued on page 112A)

What a Meter for Water!

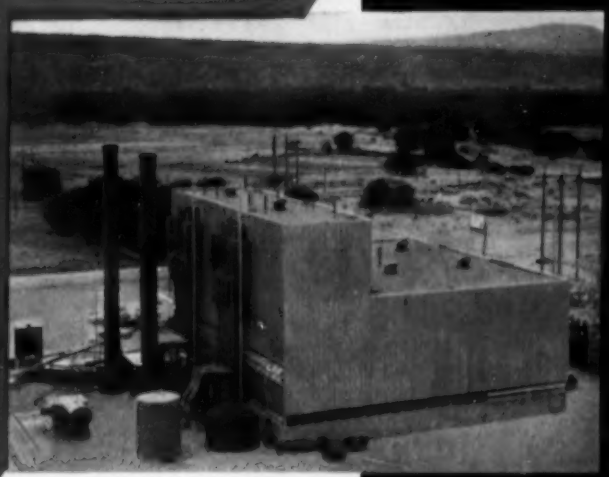


BUILDERS PROPELOFLO is an inexpensive main line meter for totalizing water consumption. Gives dependable, trouble-free service on the job. Meters accurately over wide range — six-digit totalizer shows water use directly in gallons, cubic feet, etc. For complete information on this easy-to-install meter, write to Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.

BUILDERS-PROVIDENCE
DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.
BIF METERS FEEDERS CONTROLS

four different water supplies from one water treatment plant by GENERAL FILTER

The Plains Electric Generation and Transmission Co-operative recently completed at Algodones, New Mexico, provides 30,000 kilowatts per hour to Southwest consumers.



Consulting Engineers:
Laramore & Douglass, Inc., Chicago, Ill.

A water treatment plant capable of providing suitable water in sufficient quantities for four different supplies was required by the consulting engineers:

- COOLING WATER for the condensation of turbine steam.
- SANITARY WATER for drinking and sanitation.
- MAKE-UP WATER for the boilers.
- SERVICE WATER for fire protection and general utility.

With the system installed one operator can check, alter and control the treatment process from a master control panel . . . confident of complete dependability . . . minimum maintenance.

AERATORS • FILTERS • TASTE AND ODOR • ALKALINITY CONTROL • HIGH CAPACITY RESINOUS ZEOLITE • IRON RUST REMOVAL • DEMINERALIZATION • SOFTENERS

Ask for recommendations for a water treatment plant "job-engineered" to your requirements . . . a fast, efficient, economical system by General Filter.

General Filter Company
AMES, IOWA

"yours for better water treatment"

(9th Annual Meeting) Sec'y, G. O. Fortney, State Dept. of Health, Charleston 5, W. Va.

Oct. 19-21—Des Moines, Ia.
Iowa Section A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Ia.

Oct. 20-21—Clarksburg, W. Va. *(Waldo Hotel)*
West Virginia Section A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston, W. Va.

Oct. 20-22—Atlantic City, N. J. *(Madison Hotel)*
New Jersey Section A.W.W.A. (Fall Meeting). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

Oct. 24-28—New York, N. Y. *(Hotel Statler)*
American Society of Civil Engineers. (Annual Meeting). Sec'y, Wm. H. Wisely, 33 West 39th St., New York, N. Y.

Oct. 24-28—State College, Pa. *(State College)*
Sewage Works School, R. R. Kountz, Ass't Prof. San. Engr., State College, Pa.

Oct. 25-28—Sacramento, Calif. *(Senator Hotel)*
California Section A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 26-28—Washington, D. C. *(Hotel to be announced)*
Chesapeake Section A.W.W.A. Sec'y, Carl J. Lauter, 6955—33rd St., Washington, D. C.

Oct. 30-Nov. 2—Biloxi, Miss. *(Buena Vista Hotel)*
Alabama-Mississippi Section A.W.W.A. Sec'y, Charles W. White, 537 Dexter Ave., Montgomery, Ala.

*Nov. 3-5—Roanoke, Va. *(Hotel Roanoke)*
Virginia Section A.W.W.A., Secy. J. P. Kavanagh, 213 Carlton Terrace Bldg., Roanoke, Va.

* This is a correction from previous listing.

Nov. 6-9—Orlando, Fla. *(Hotel to be announced)*
Florida Section A.W.W.A. Sec'y, Harvey T. Skaggs, P.O. Box 2328, Jacksonville, Fla.

Nov. 6-9—Orlando, Fla., *(Orange Court Hotel)*
Florida Sewage & Industrial Wastes Association (Annual Meeting) Sec'y-Treasurer, M. E. Dawkins, P.O. Box 210, Jacksonville, Fla.

Nov. 14-16—St. Louis, Mo. *(Chase Hotel)*
Concrete Pipe Short Course (Annual), Howard F. Peckworth, American Concrete Pipe Assn., 228 N. LaSalle St., Chicago 1, Ill.

Nov. 14-16—Winston-Salem, N. C. *(Robert E. Lee Hotel)*
North Carolina Section A.W.W.A., Secy. Wilber E. Long, Jr., 1616 Bickett Blvd., Raleigh, N. C.

Nov. 14-18—Kansas City, Mo. *(Municipal Auditorium)*
American Public Health Association (83rd Annual Meeting). Exec.-Sec'y, Dr. Reginald M. Atwater, 1790 Broadway, New York, N. Y.

Nov. 16-18—Allerton Park, Ill. *(Univ. of Illinois)*
Water Works Management Short Course, Director Dr. T. E. Larson, State Water Survey, Urbana, Ill.

Dec. 14—Augusta, Me.
Maine Water Utilities Association. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

KENT, OHIO, "GETS AT THE ROOT"

of a 10 Year Sewer Headache!

This six foot root, which nearly filled the 10" sewer line on Prospect Avenue, was part of a short morning's work. For nearly 10 years the line had been a constant source of trouble with continual complaints from residents.

The "Flexible" Bucket Machine shown in the background did the cleaning work. This versatile machine will remove all kinds of deposits from the sewers and bring them to the street surface, and, without the necessity of working at the bottom of the manhole.

In the picture, Service Director Will A. Beans points to the roots as workers, left to right, Kenneth White, John Yokoboskie, and Dave Bachtel, hold the collection.

Put an end to your sewer cleaning headaches; investigate the advantages of "Flexibles." Catalog 55-A describing all modern sewer cleaning methods is available FREE, or a FREE demonstration is yours for the asking.

Flexible INC.
3786 DURANGO AVE., LOS ANGELES 34, CALIF.
(Distributors in Principal Cities)

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

Before you plan your sewer system it will pay you to consider carefully all the advantages listed on this page. They are typical of those that Transite® Sewer Pipe has provided. Among them are real money-saving advantages important to all concerned with sewer systems . . . the contractor, the engineer, the taxpayer. And among them, in all likelihood, are many that Transite Pipe can put into effect *under your own sewer system conditions.*

Typical System Design Advantages

- Installed in shallower trenches
- Savings in amount of material excavated
- Smaller earth loads
- Elimination of cradling
- Location of treatment plant at higher level
- Elimination of pumping
- Use of smaller diameter pipe
- Installation at flatter slopes

Typical Installation Advantages

- Fewer joints
- Easier handling
- Smaller crews
- Speedier assembly
- Assurance that joints pass severe infiltration tests

Typical Operation Advantages

- Infiltration treatment cost drastically reduced
- Only normal sewage treated

Typical Maintenance Advantages

- Tree roots kept out—minimizes cleaning
- Sewers kept smooth and intact—pipe stays strong, joints stay resilient
- Need for frequent inspections reduced

For further information and your copy of TR-94A, helpful, widely used Sewer Design Flow Chart based on the Manning Formula, write Johns-Manville, Box 60, New York 16, New York

Johns-Manville TRANSITE SEWER PIPE

the asbestos-cement sewer pipe for tighter systems

Mounts on Conventional Truck

The completely new, ½-yd., 9-ton H-5 Hydrocrane brings you the work ability of heavy carrier-mounted cranes at small-crane cost. Because of its hydraulic outriggers this crane-excavator can be mounted on a commercial motor truck, new or used, without sacrificing any of its basic working ability. These outriggers give the Hydrocrane greater stability and lifting capacity than much heavier machines.

BUCYRUS ERIE HYDROCRANE BUCYRUS ERIE HYDROHOE

9-Ton Hydrocrane

50-Ft. Boom Telescopes to Half Length For Travel . . . . . .

High-lift, 3-piece boom (extra equipment at added cost) gives you 50 feet of reach, retracts to 25 feet for traveling. When machine arrives at job site, boom and hydraulic fittings can be connected and the machine working in less than 10 minutes.

Both the 2-piece standard boom and 3-piece erector's boom extend and retract 12 feet — hydraulically. You can change boom length *while you're working* — move a load in and out of buildings or close quarters without moving crane an inch.

All-Hydraulic Action Means Precision Control . . . . .

Every crane function is fully hydraulic — boom and line hoist, swing, outrigger set and retract, boom telescope, bucket open and close. Control is so precise loads can be inched into place when necessary, yet line speed is up to 240 fpm.

The H-5 Hydrocrane's combination of 18,000 lb. maximum lift, 50-ft. boom plus 20-ft. jib, and 50-mph top travel speed opens greatly expanded job opportunities—particularly when all these features are packed into a unit that can meet highway laws for over-all length and axle loads (depending upon truck selection.)

Bucyrus-Erie Company
South Milwaukee, Wisconsin

Gentlemen:
Send me your new H-5 Bulletin. This crane interests me for.....work.
(type of job)

Name.....
Company.....
Title.....
Address.....
City.....
State.....

100H55C

- ★ ½-YD., 9-TON CAPACITY
- ★ 50-MPH TRAVEL SPEED
- ★ UP TO 240-FPM LINE SPEED
- ★ 24 TO 36-FT. STANDARD TELESCOPING BOOM
- ★ 38 TO 50-FT. HIGH-LIFT TELESCOPING BOOM
- ★ UNMATCHED PRECISION CONTROL OF LOADS
- ★ AVAILABLE WITH CLAMSHELL, CRANE HOOK, MAGNET, CAB
- ★ OPTIONAL REMOTE TRUCK CONTROL FROM CRANE CAB

1880 **BUCYRUS-ERIE COMPANY** 1955

South Milwaukee, Wisconsin

75 **Years of Service to Men Who Shape the Earth**

See It In Action

Find out what the new H-5 Hydrocrane can do for you. Ask your Bucyrus-Erie distributor about a demonstration.

W & SW

Spillway

OVERFLOW FROM THE MAIN SECTION

William Storrie Passes

A Canadian Pioneer Sanitary Engineer

William Storrie, president of the engineering firm of Gore & Storrie of Toronto, Canada, and long a leading figure in the field of water supply and sewage treatment, passed away in his home on May 31st while sitting in a chair.

"Bill" Storrie, a Scotsman and proud of it, was born in Paisley, Scotland, on October 8th, 1883. He came to Canada in 1909, and his first job was that of resident engineer on the construction of Toronto's first filtration plant. Later he served Ottawa as Water Works Engineer. In 1919 he became associated with the late Wm. Gore and Dr. Geo. Nasmith in the formation of the firm of Gore, Nasmith & Storrie, specializing in water and sewage works design and construction. His latest activity was that of consultant to the new Municipality of Metropolitan Toronto in coordinating, integrating and improving the many water and sewage systems serving contiguous municipalities taken into the new Metropolitan District of Toronto.

Mr. Storrie had taken an active leadership in the Canadian Section of AWWA, of which he was a past-chairman, and in the Canadian Institute on Sewage and Sanitation, of which he was a past-president and later a member of the Federation of Sewage and Industrial Wastes Assn.'s Board of Control. He was a member of the Engineering Institute of Canada, the Ontario Ass'n of Professional Engrs. and Great Britain's Institution of Civil Engrs.

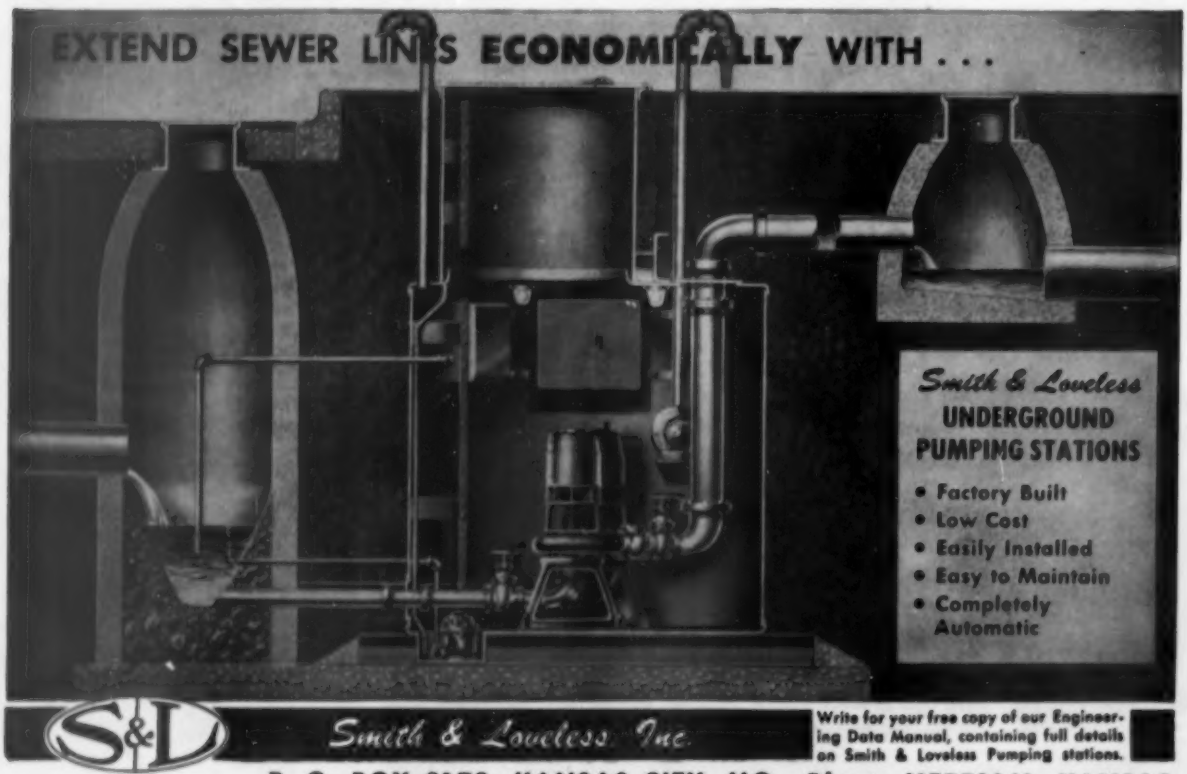
In the matter of honors and awards he had received the Geo. W. Fuller Award of AWWA; the Dexter Brackett Medal of NEWWA, and the Kenneth Allen Award of the Federation of Sewage and Industrial Wastes Ass'n, in recognition of services rendered or papers presented.

As earlier stated, "Bill" Storrie was proud of being a Scotsman, and loved and served Canada well as a leading and pioneering sanitary engineer, with many water and sewage treatment plants to his firm's credit —those of Toronto and Ottawa being perhaps the most important.

* * *

Dayton, Ohio, to Construct Lime Recovery Plant

Construction of a $900,000 lime recovery plant at the Dayton, Ohio, water filtration and softening plant was recently approved by action of that city's Commission. The plant according to the consulting engineers will recover enough pure lime to meet the city's water softening needs, plus a surplus for sale in that area.


EXTEND SEWER LINES ECONOMICALLY WITH . . .
Smith & Loveless
UNDERGROUND PUMPING STATIONS
• Factory Built
• Low Cost
• Easily Installed
• Easy to Maintain
• Completely Automatic
S&L
Smith & Loveless Inc.
Write for your free copy of our Engineering Data Manual, containing full details on Smith & Loveless Pumping stations.
P. O. BOX 8172, KANSAS CITY, MO., Plant, MERRIAM, KANSAS

The new plant is estimated to save the city about $156,000 the first year of operation and to pay for itself within five years. In 1954 the city paid $315,000 for 20,440 tons of lime for water softening. The lime reclamation plant could produce that amount of lime for $194,540, according to Black and Associates Inc., of Gainesville, Fla., the consultants. The project is expected to be financed by a new revenue bond issue.

Harry A. Faber Joins Public Health Service

Harry A. Faber, managing editor of *Water and Sewage Works* for the past three years, has been appointed Sanitary Engineering Research Grants Officer with the Public Health Service, U. S. Department of Health, Education, and Welfare, at Washington, D. C. The appointment became effective July 1.

In his new capacity, Mr. Faber will appraise and evaluate research in sanitary engineering carried on at universities and other research institutions throughout the United States, both outside and within the Federal government; determine areas of need; and recommend methods for strengthening research efforts through such means as research and fellowship grants. He will work closely with all PHS authorities interested in sanitary engineering research, including the National Institutes of Health and the Robert A. Taft Sanitary Engineering Center.

Mr. Faber received the B.S. degree from Cornell University in 1930, and remained there as instructor in sanitary chemistry until 1933. The next two years he worked as research chemist for Consolidated Water Company, Utica, N. Y. From 1935 to 1952, he was research director with the Chlorine Institute, Inc., New York, N. Y., leaving there to join the *Water and Sewage Works* staff in January 1952. Among other contributions to the field of sanitary engineering, he is credited with basic research studies which led to present concepts of free residual chlorination, to the application of chlorine for treatment of wool-scouring wastes, and to the development of a chlorination process for the destruction of cyanides.

Mr. Faber's new office address will be: c/o Office of Engineering Resources, Division of Sanitary Engineering Services, Public Health Service, U. S. Department of Health, Education, and Welfare, 4th and "C" Street, S. W., Washington 25, D. C.

(Continued on page 118A)

92 Miles of Tough Sewer Sealing Problems Solved at Gulfport...

with cold applied **KALKTITE®**

Gulfport, Miss., recently tackled its first complete sanitary sewer system . . . 485,000 ft. of 6" to 36" pipe laid under very difficult construction conditions . . . normal ground water level averaging approximately 18" below ground and subsoil consisting of fine white sand. Every lineal foot of trench had to be de-watered by an elaborate well point system operating continuously.

Presstite's KALKTITE compound was selected to seal the sewer joints under these tough conditions because it is . . .

- ***mixed and applied cold*** on the job.
- ***so highly adhesive*** to the pipe that it makes tight joints even under adverse pipe laying conditions.
- ***tough and flexible,*** allowing for normal sewer line settlement and some alignment deflection during backfilling.
- ***unaffected by acids,*** gases and alkalies of sanitary sewers and contains an ingredient poisonous to vegetation and tree roots.
- ***economical to use,*** allowing installation of more joints per man, per hour, per day.

The engineers' check for water infiltration shows the bulk of the lines have such negligible infiltration that no infiltration tests were necessary.

PRESSTITE Sealing Compounds

Write today for more detailed information on the superior qualities of cold applied KALKTITE sewer joint sealing compound.

PRESSTITE ENGINEERING COMPANY

3780 Chouteau Ave., St. Louis 10, Missouri

Wertz New Head of Miami's Dept. of Water and Sewers

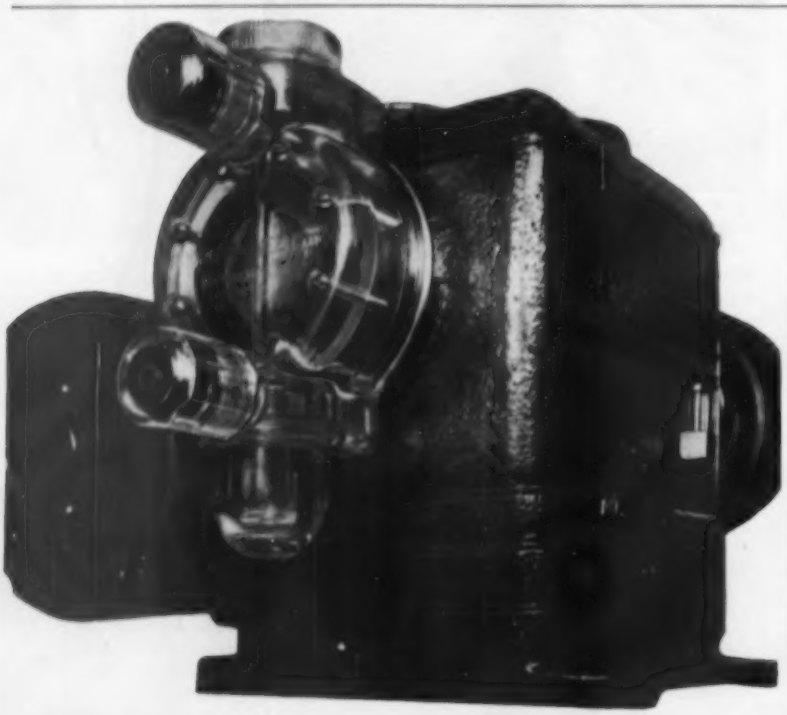
Glass Retires but Retained as Consultant.

Effective July 1, 1955, C. F. "Caesar" Wertz became head of the $65,000,000 Dept. of Water and Sewers of Miami, Fla.

Wertz, for a number of years representing Day & Zimmerman as Resident Engineer with the Department, succeeds Wm. A. Glass as Director. Mr. Glass retires at 71 years of age after having held the position for 14 years under City ownership and prior thereto under private ownership. He will now serve as Consultant to the Water and Sewers Board.

Wertz is a native of Reading, Pa. From his first name, Claudius, he came by the nickname "Caesar" while in high school. His second nickname, "Dutch," is a natural. He is an alumnus of Pa. State College, and for a number of years was connected with Fuller & McClintock, well known consulting sanitary engineers. Later he became associated with Day & Zimmerman of Philadelphia, and was sent to Miami at the time that the City took over the water company. As Resident Engineer, his principal job was to serve in the interest of the bondholders. He soon became invaluable to the Department of Water and Sewers in its tremendous expansion program involving new water treatment plants, pumping stations, main enlargements and distributed storage. The latest projects are the $27,000,000 sewage treatment plant, now under construction, and the $4,295,000 construction program for bettering water supply service during 1955.

The Department's facilities are valued at $65,000,000, and employees will number better than 400 when the new sewage treatment plant begins operation.



THREE GOOD REASONS FOR SELECTING **Chem-O-Feeder**

1. *All-purpose pump* — corrosion-proof measuring chamber safely handles almost all water treating chemicals — at rates from 0.2 to 57 gals. per hour.
2. *Complete kit* — furnished with all necessary items for quick easy installation — easily adapted to all types of constant rate or flow proportional feeding systems.
3. *Maintenance-proof design* — complete feed control mechanism operates in "oil bath" lubrication.

See how Proportioneers Chem-O-Feeder can solve your water treating problems — write for Bulletin 1225. Proportioneers, Inc., 350 Harris Ave., Providence 1, R. I.

PROPORTIONEERS
DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.
METERS FEEDERS CONTROLS

Julius W. Bugbee Dies

Retired Supt. of Providence Sewage Plant

Julius W. Bugbee, retired superintendent of the Providence, R. I., sewage treatment plant, died July 20 after a lengthy illness.

Mr. Bugbee was graduated from Worcester Polytechnic Institute in 1890. After serving as chemist and draftsman for the City of Worcester for several years, he went to Providence to take charge of the Fields Point sewage treatment plant. For several years he was in charge of treatment at the water works at Pettaconsett and Scituate before that was taken over by the Providence Water Supply Board. He retired in 1943.

Mr. Bugbee was elected to honorary membership in the Federation of Sewage and Industrial Wastes Associations in 1942, and had been a member and former president of the New England Sewage and Industrial Wastes Association.

Pickups from Purdue's Sanitary Engineering News

Don E. Bloodgood, Editor

"Tol-E-Gro," the sludge product sold by the City of Toledo, Ohio, netted $8201.40 on the 672.88 tons sold in 1954.

* * *

A 28.5-inch liquid depth septic tank gave better year-round performance than an equal capacity 62-inch liquid depth tank. Andbody know why?

* * *

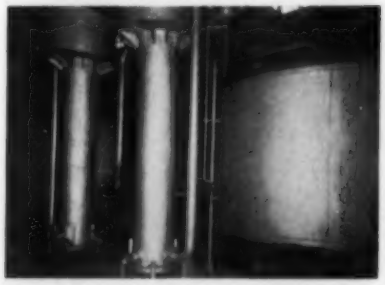
The world's largest incinerator (900 tons per day) has gone into operation in Miami, Florida.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

W&SW

New Equipment

High Iron Removal At Low Cost



901

Aquatrol Ferr-X Corporation, Clifton, New Jersey, has announced the development of a new non-chemical aeration process which makes available high iron removal at low iron removal costs. This new non-chemical system has been in successful operation for more than a year in several plants and has proven its ability to remove iron from high iron bearing waters.

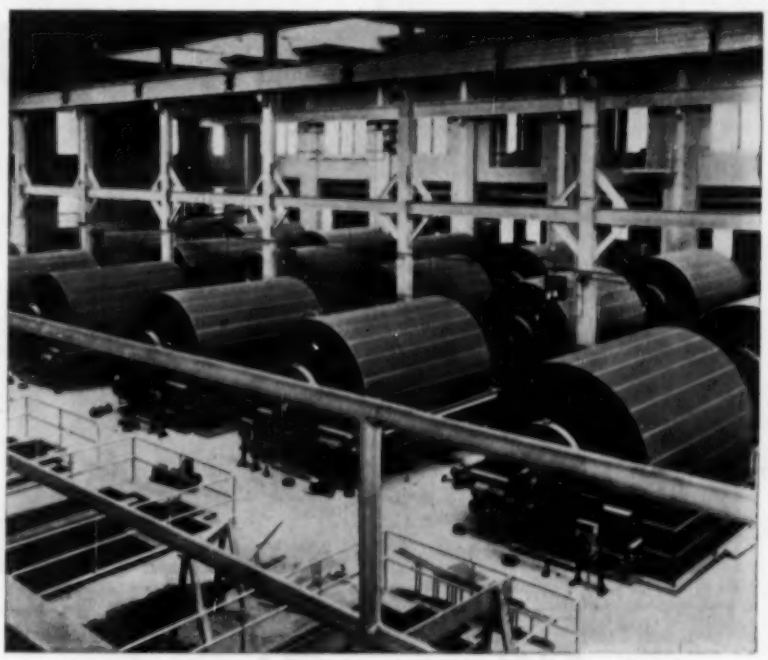
The Aquatrol Ferr-X High Iron Removal Filtration System operates as follows:

The raw water enters the aerator with accurately measured compressed air through two separate diffusers at the bottom of the aerating column. The water and air then pass upward through the patented calibrated Ferr-X packing in the aerator column so that the greatest possible air and water surface contact is obtained. Therefore, this type of system uses the least amount of air of any present day iron removal system. In addition, the possibility of outside contamination is completely eliminated in this type of system.

The upper portion of the Aquatrol Ferr-X aerator is a disengaging chamber and small retention tank that is unique in closed aeration systems, where the excess gases and many gases contained in the raw water are separated and released by automatic level control equipment.

From the Aquatrol Ferr-X aerator the water containing precipitated (ferric hydroxide) iron then passes into the filter where all filtrable solids are removed and the effluent water contains no more than 0.3 ppm of total iron, no objectionable gases and greatly reduced CO_2. It should be noted that all phases of the operation are completely controlled—air is metered—water is metered—gas release

(Continued on page 120A)



Get higher efficiency from your vacuum filters with Pennsalt Ferric Chloride

Pennsalt Ferric Chloride provides *maximum* coagulating and flocculating action for dewatering sludge by vacuum filtration. This *more effective* action reduces the load on your filters . . . increases the yield per filter . . . holds filter downtime to a minimum . . . gives you a drier, easier-to-handle cake.

Whether you run a large plant or a small community operation, it pays to use Pennsalt Ferric Chloride. It is available in two easy-to-use forms: anhydrous $FeCl_3$ in drums, or a concentrated aqueous solution in tank cars. For further information on Ferric Chloride and its use in conditioning sewage, call our nearest District Office. Or write: Pennsylvania Salt Manufacturing Co., Industrial Chemicals Division, Three Penn Center Plaza, Philadelphia 2, Pa.

OTHER PENNSALT CHEMICALS FOR WATER AND SEWAGE TREATMENT: Alum, chlorine, chlorinated lime, Perchloron® (high-test calcium hypochlorite).

Pennsalt District Offices

Appleton, Wis.—Appleton 3-9307
Decatur, Ga.—Evergreen 9690
Chicago 1, Ill.—Andover 3-6170
Cincinnati 2, Ohio—Main 1-3168
Cleveland 15, Ohio—Main 1-6205
Detroit 26, Mich.—Woodward 1-8051
Paterson 1, N. J.—Lambert 5-3500
Philadelphia 2, Pa.—LOcust 4-4700
Pittsburgh 19, Pa.—Atlantic 1-5233
St. Louis 1, Mo.—Central 1-2338

Pennsalt Chemicals

PENNSYLVANIA SALT MANUFACTURING COMPANY

mechanism is automatic and installation can be made to provide automatic start and stop.

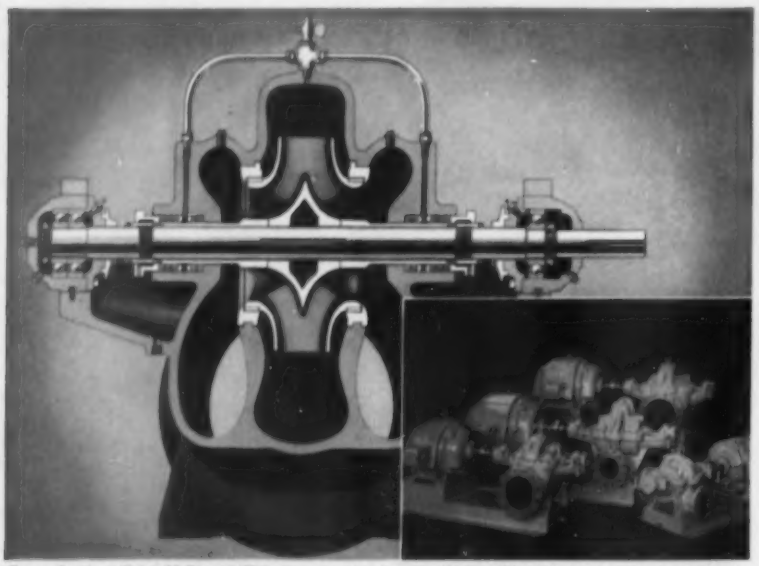
New Trap Lures Over 50,000 Flies A Day

902

Fly Control Corporation, Tulsa, Oklahoma, has developed a practical, positive method of fly control. Designed for use in highly populated fly areas, this new fly trap has been proven effective at more than 50 installations.

This fly trap, developed by H. B. Smith, D.V.M., is the result of more than 20 years of study of flies and their habits. Named the Smith Poly-Gruv Fly Trap, the device, made of aluminum, is simple in design, easy to maintain, easy to clean, completely portable, and rugged enough to withstand years of use. Measuring 4 feet long, 3 feet high and 32 inches deep, it is capable of catching over 50,000 flies a day. It is effective in an area up to 450 yards in diameter, making it possible for entire communities to eliminate the fly problem.

Using a specially prepared non-poisonous fly lure, the flies are attracted, trapped and die within 12 hours for lack of water. Since the lure needs only occasional attention and replacing, and the trap is large enough to hold weeks of fly inflow, the cost of fly control is reduced to a minimum.



Cross Section Type M Pump. This construction is used, with minor variations, in all sizes 4" and larger.

Group of Double Suction Pumps ready for installation in municipal water works.

Worry-Proof

YOUR PUMPING PROBLEMS with WHEELER-ECONOMY PUMPS

This cut-away section of a Wheeler-Economy Type "M" Pump shows engineering that means around-the-clock, around-the-calendar performance . . . peace of mind for the men in charge. Longer life and less maintenance work results from these important features . . . The method of supporting the rotor between outboard bearings with end-thrust practically eliminated . . . horizontally split casing with all pipe connections in lower half so that rotating parts can be removed without disturbing connections or pump alignment . . . Inlet designed to reduce leakage and friction losses . . . Double-bearing construction provides for longer packing life . . . Low pressure stuffing boxes . . . Wearing parts readily renewable.

To insure correct application for your municipal or industrial project, Wheeler-Economy offers specialized engineering service as well as a wide selection of pump sizes and cases. Write for CATALOG A-1052.

WE-512

WHEELER-ECONOMY PUMPS

ECONOMY PUMPS INC. - DIVISION OF C. H. WHEELER MANUFACTURING CO.
19TH AND LEHIGH, PHILADELPHIA 32, PA.

Easy-Set, Self-Adjusting, Tubular Steel Wrench

903

The Stilsomatic Sales Corporation, Washington, D. C., now offers an entirely new pipe wrench instituting four unique features: (1) Tubular steel construction, (2) Automatic adjusting, Rocking Fulcrum action, (3) Spring loaded hook jaw and (4) Light weight.

Forged from high carbon steel, tempered for maximum strength, durability and lightness, the Red Snapper is unconditionally guaranteed against breakage. Its weight is generally 50% less than competitive products.

The Rocking Fulcrum action allows a number of different pipe fits with only one adjustment. For example a setting for a 1½" pipe will also accommodate 1¼" or 2" sizes. This fulcrum action also permits a snap on feature not found in any other wrench.

Once the jaws of the Red Snapper are placed on a pipe the spring loaded hook jaw exerts a constant pressure and will hold the wrench in place; thus requiring only one hand for any operation.

The Red Snapper 12"-14"-18" is now in production. Very shortly the Red Snapper will be available in three additional sizes: 24", 36", 48".

New Sewer Pipe

904

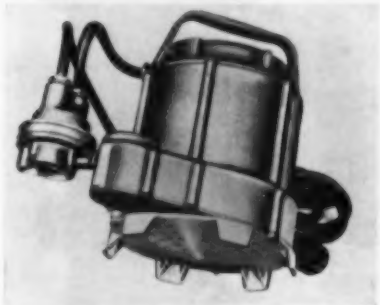
Armco Drainage & Metal Prod-

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

ucts, Inc., Middletown, Ohio, has developed a new and improved type of sewer pipe known as "Smooth-Flo" pipe, it is reported to have all the structural advantages of corrugated metal pipe with top flow capacity and the extra durability of a complete smooth, centrifugally spun bituminous lining.

According to the manufacturers, "Smooth-Flo" pipe was developed especially for sewer uses, and is recommended for storm, sanitary or combined sewers. It is said to offer a flow capacity equal to or better than other sewer pipes, yet retains all the advantages of the flexible type of pipe.

High Capacity Submersible Pump



905

Kenco, Inc., Lorain, Ohio, has developed a new, high-capacity, low price submersible pump for commercial use that has a capacity of 5,000 gallons per hour at low heads, 55 gallons per minute at 20 feet, and 25 gallons per minute at 28 feet. Called the Kenco OID, it is ideal for use any place where a large gallonage of water has to be automatically pumped in a hurry.

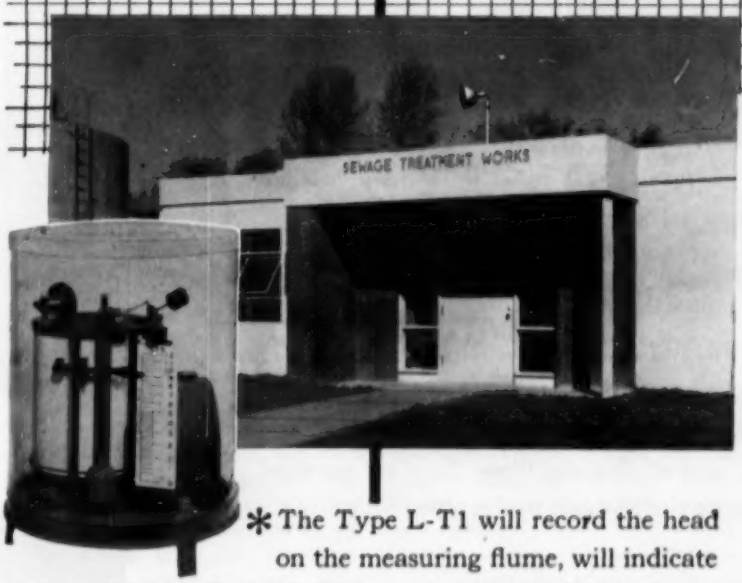
The Kenco OID is reported to be the greatest capacity submersible utility pump ever offered at its price. Yet despite its capacity, the unit weighs but 50 lbs., and is only 13" in diameter by 11⅛ inches high. As a result the pump is so light it can be carried in one hand, and so small that it can be installed in close-fitting sumps.

Another new feature in the Kenco OID is a re-designed "No-Float" 2-stage liquid level control incorporating a unique General Electric Snap-Action Switch. This new switch and control assures foolproof, perfect operation since there are no floats to stick, rods to bend, or electrodes to corrode and foul.

(Continued on page 123A)

PROBLEM:
To obtain at minimum cost the essential information on flow required for efficient operation of a small sewage treatment plant.

SOLUTION:
Stevens Type L-T1 Recorder*



* The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

STEVENS DATA BOOK

...invaluable for your reference file
144 pages of technical data on recorder installations...plus a wealth of hydraulic tables and conversion tables. **Send $1.00 (No C.O.D.'s)**

CONSULT WITH STEVENS INSTRUMENTATION SPECIALISTS

LEUPOLD & STEVENS INSTRUMENTS, INC.
4445 N. E. GLISAN STREET • PORTLAND 13, OREGON
Foremost in Precision Hydraulic Instruments Since 1907

122A

. . . And Ring-Tite Joints for RENSSELAER-COREY HYDRANTS

Now for the first time, Rensselaer Hydrants as well as valves are available with Ring-Tite Joints.

•

CONSTRUCTION TIME REDUCED

This feature will speed up hydrant installations and provide tight, flexible joints.

•

FOR ALL SIZES

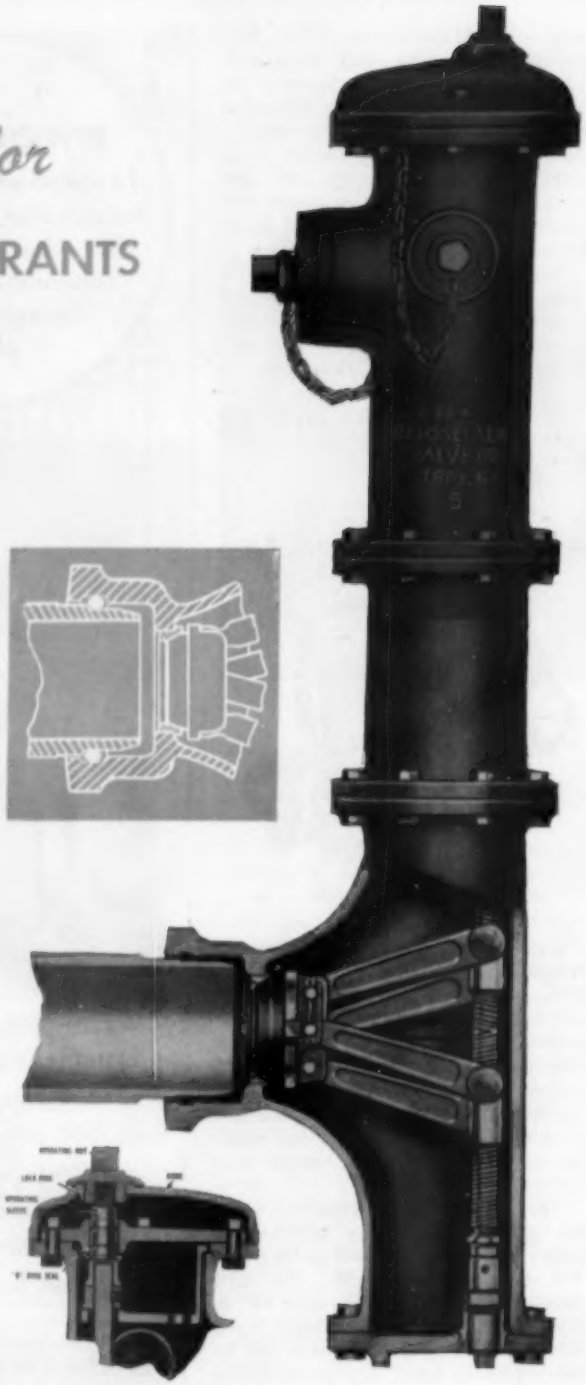
Rennselaer Fire Hydrants 4" and 5" with Ring-Tite Bells can be connected to 4" and 6" and 8" Transite Pipes. Lugs are provided to tie the Hydrant to the pipe line.

•

Rensselaer Fire Hydrants are designed on the knuckle joint principle and open with the pressure. They are quick opening with free-flow, long radius curves. Will not freeze or flood and no digging is required for repairs or standpipe breakage.

The Rensselaer Hydrant has been preferred by superintendents, fire chiefs and maintenance men for more than half a century.

Ask for Bulletin G.



RENSSELAER HYDRANT WITH "O"-RING SEAL AND RING-TITE JOINT.

Rensselaer VALVE CO. TROY, N. Y.

GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES • CHECK VALVES • AIR RELEASE VALVES

SALES REPRESENTATIVES IN PRINCIPAL CITIES

Division of the Ludlow Valve Manufacturing Co., Inc.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Torque Reducer For Large Size Valves

906

Hills-McCanna Company, Chicago, Ill., has introduced a new planetary gear torque reducer which permits "one-man" operation of their 10", 12" and 14" Saunders Patent Diaphragm Valve. The torque reducer provides a 5 to 1 mechanical advantage, and is available on either handwheel or chain-operated valves.

The simple gearing device is available on new valves or may be applied to valves already in service. The gear assembly is mounted at the top of the bonnet and increases the overall height of the valve by only 7½". No other dimensions are changed.

Toledo Adds Vermette Power Drive To Its Line of Pipe Tools

907

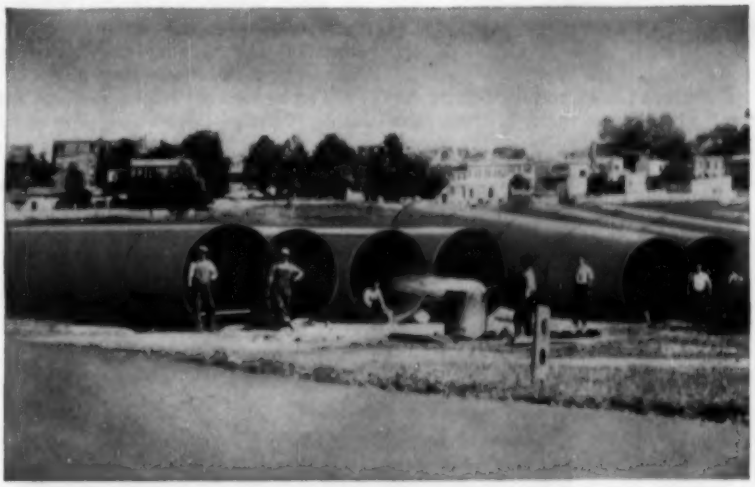
The Toledo Pipe Threading Machine Co., Toledo, Ohio, has announced a new addition to its line of pipe tools and machines — the Toledo No. 78 Vermette Power Drive which is already well-known under the Vermette name.

This Power Drive features extra heavy-duty construction combined with compactness and light weight. The complete unit with folding tripod legs weighs only 75 pounds, and it can be carried and operated by one man.

The Toledo No. 78 Power Drive is one of the most versatile machines of its type on the market.

(Continued on page 124A)

Life begins at forty
for steel pipe like this



THIS PICTURE WAS TAKEN IN 1915. Ever since, this 84-inch steel pipe has been an important part of Baltimore, Maryland's water system, distributing water from the Montebello Filtration Plant. It is protected against corrosion by Bitumastic Enamel.

This picture was taken forty years ago, right after this steel pipe had been hand-brushed with Bitumastic® Enamel. Thanks to this protection against corrosion, these mains are *still* an important part of Baltimore's water system. And the end of this pipe's useful service life is nowhere in sight.

SEWAGE EQUIPMENT PROTECTION!

Koppers also makes Bitumastic® Protective Coatings for all kinds of sewage-plant equipment. Give your expensive equipment the effective protection it deserves. Write for complete data.

A recent inspection bears out this statement. A group of water works engineers examined the 70-B Enamel Coating and reported it to be in excellent condition.

A 40-year record is good; but nowadays, even better records can be expected. Today, Bitumastic Enamel is applied *mechanically* to exterior and interior surfaces of pipelines, thus providing thicker protection, more uniform protection. And Bitumastic Enamels, themselves, are even better products.

Service records like this prove that it pays to use strong steel pipe, protected by Bitumastic Enamel. It's an economical combination for your large-diameter water lines. Write for full information.

KOPPERS ®

MADE ONLY BY KOPPERS

BITUMASTIC ENAMELS

KOPPERS COMPANY, INC., Tar Products Division

Dept. 961-T, Pittsburgh 19, Pennsylvania

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

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It can be used for all cutting, reaming, threading, and fitting operations. The chuck takes only a few seconds to set up; handles ⅛" to 2" pipe and conduit; chuck grips, tightens and centers pipe automatically in forward or reverse; screws fittings on tighter than possible by hand.

"Wedge-Lock" Clay Pipe

908

Robinson Clay Product Co., of Akron, Ohio, has announced that "Wedge-Lock" clay pipe, the economical new root-proof, infiltration-proof, labor-saving vitrified clay pipe for homes, industries and sanitary systems, is now in full production.

Developed by Robinson, deliveries of "Wedge-Lock" clay pipe are now being made.

The new development features an integral double-ball mechanical joint of tough, corrosion-resistant plastisol. The factory-made joint is cast inside the bell and on the spigot of low-absorbtion Robinson clay pipe.

The answer to expensive line failures, "Wedge-Lock" clay pipe can be installed easily and safely under basement floors and in structural walls, as well as in sewer connections for homes and other structures and in public sanitary lines.

For tomorrow's expansion call in NATIONAL *today!*

Like Atlanta, Ga., *you* too can meet tomorrow's increased water demands with *clean water mains.* When the coefficient of sections of Atlanta's 45 year old main dropped to a low of 44, Waterworks General Manager, Paul Weir ordered National cleaning. Results were outstanding. Water pressure and capacity doubled, giving better fire protection and higher water pressure to outlying sections.

Do as other leading cities have done—let *National* cleaning provide for tomorrow's expansion without capital expenditure today! We can prove that National cleaning is an investment—not an expense.

Write us today!

NATIONAL WATER MAIN CLEANING COMPANY
50 Church Street • New York, N. Y.

ATLANTA, GA; 333 Candler Building • BERKELEY, CALIF; 905 Grayson Street • DECATUR, GA; P. O. Box 385 • BOSTON, MASS; 115 Peterboro Street • CHICAGO; 122 So. Michigan Avenue ERIE, PA; 439 E. 6th Street • FLANDREAU, S.D.; 315 N. Crescent Street • KANSAS CITY, MO; 406 Merchandise Mart and 2201 Grand Avenue • LITTLE FALLS, N.J.; BOX 91 • LOS ANGELES; 5075 Santa Fe Avenue • MINNEAPOLIS, MINN; 200 Lumber Exchange Building • RICHMOND, VA; 210 E. Franklin Street • SALT LAKE CITY; 149-151 W. Second South Street • SIGNAL MOUNTAIN, TENNESSEE; 204 Slayton Street • MONTREAL, CANADA; 2032 Union Avenue • WINNIPEG, CANADA; 576 Wall Street • HAVANA, CUBA; Lawrence H. Daniels, P.O. Box 531 • SAN JUAN, PUERTO RICO; Luis P. Caratini, Apartado 2184.

Koroseal Joint For Clay Pipe Is Root-Proof, Waterproof

909

The B. F. Goodrich Co., Industrial Products Div., Akron, Ohio, has developed a Koroseal molding compound, that permanently seals joints in clay pipe, to provide a completely root-proof, watertight line.

The new compounds are supplied in liquid plastic form to clay sewer pipe manufacturers who process the material into tough but flexible sealing rings.

According to the company, contractors will receive the new pipe with rings of Koroseal material molded permanently at the ends of each pipe section. At the shaft end of the pipe, a Koroseal ring is molded to the outside surface; at the bell end of the pipe, a ring is molded to the inside surface of the bell. When the two ends are pushed together, the rings squeeze tightly against each other to form a mechanical, compression seal that remains effective far longer than any other known pipe-joint sealant.

Hollow-Shaft Vertical Motors

910

General Electric Company's Medium Induction Motor Dept., Schenectady, N.Y., has announced a new line of hollow-shaft vertical motors designed specifically for the pumping industry.

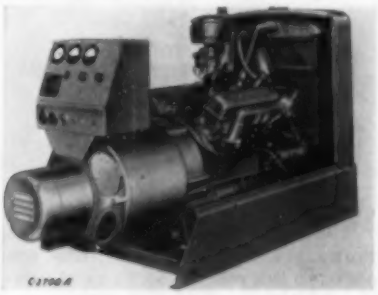
Available now in ratings of 40 hp and up, in frame sizes 404 through 6330, and in ratings from 7½ hp and up in early 1956, the new line of motors represents a complete redesigning of all major parts.

According to G-E engineers, installation, inspection, and maintenance has been made easier by using a lightweight cap (made of aluminum in the larger sizes) which can be lifted by one man. When the cap is removed, couplings and bearings are

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

available for inspection, and all installation attachments and impeller adjustments can be made without further disassembly. The motors are so designed that couplings can be changed in a few minutes with ordinary tools, they said.

Economical, Stand-By Electric Plants



911

D. W. Onan & Sons Inc., Minneapolis, Minn., has announced the development of two new series (25,000 and 35,000 watt) of Ford-powered electric generating plants.

Both of these new series of electric plants are available in either fully housed or unhoused models. All models are equipped with rugged sheet metal control box mounted over the generator. Control features include engine instruments, high-water-temperature and overspeed shutdowns, A.C. voltage regulator, field rheostat and A.C. voltmeter. A circuit breaker and A.C. ammeter are standard accessories on the housed units, optional on the unhoused models.

Portable Power Pipe Threader

912

Velocity Power Tool Co., Pittsburgh, Pa., has announced the development of a new Lawco Junior Portable Power Pipe Threader that provides quick and easy pipe threading on the job.

Designed and constructed for one hand operation, the threader weighs only 20 pounds and is 27 inches in length. Simple adapters and a speed reducer make it possible to handle pipe from ¼-inch up to 10 inches.

Operation is extremely simple. Apply the threading dies to the tool, position the tool, then press a button and the power unit drives the cutting dies. It is equipped with a ¼-horsepower electric motor and a toggle switch to provide reversible power.

(Continued on page 126A)

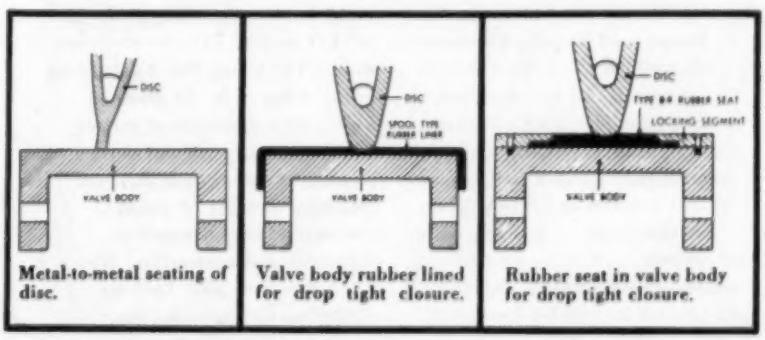
For Flow Control

Butterfly Valves

Offer These Advantages

1—Minimum Restriction to Flow
2—Minimum Turbulence
3—Non Clogging—Self-Cleaning
4—Always Easy to Open and Close
5—Manual or Automatic Control
6—Lower Installation Cost
7—Light Weight—Compact
8—Reduced Installation Space
9—Less Maintenance

42"—125# butterfly valve with hard chrome edged disc, stainless steel shaft, bronze bearings and enclosed worm gear, handwheel operator. Valve body lined with rubber for drop tight shut-off at 140 p.s.i. water pressure.



Metal-to-metal seating of disc.

Valve body rubber lined for drop tight closure.

Rubber seat in valve body for drop tight closure.

In W. S. Rockwell Butterfly Valves you have the most completely engineered line for water works, sewage and industrial waste treatment plants. Standard valves are built in sizes to 72" for 25, 50 and 125-lb., in any desired metal, with manual or automatic operators. Larger sizes can be built to specifications. Write for new catalog.

W. S. ROCKWELL COMPANY

ROCKWELL BUILT SINCE 1900

BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

2825 ELIOT STREET • FAIRFIELD, CONN.

Sales Representatives in Principal Cities

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Two Types Of Desludging For Solids-Contact Unit

913

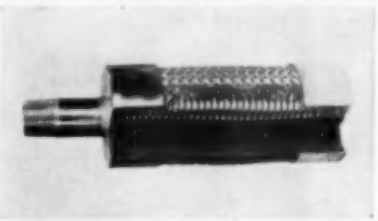
Graver Water Conditioning Co., New York, N. Y., is now offering two different types of desludging controls for its solids-contact unit, the Reactivator.

These controls have proven highly effective in controlling the shallow, dense sludge zone of the Reactivator which produces the minimum of carryover so essential to any solids-contact unit.

The flow-proportioned control is initiated by a flow meter which sets in successive operation first the backflush and then the blowdown valve. Each predetermined volume of water passing through the flow meter delivers an electric impulse to a counter. When the desired number of contacts has been made the counter starts the backflush timer.

In the time cycle desludging control two staggered by synchronized repeat cycle timers individually operate first the backflush valve, then the blowdown valve, as the backflush valve closes the blowdown valve opens. Then both remain closed until the backflush valve reopens and the cycle is repeated. In this way, a controlled amount of sludge is continually removed from the Reactivator.

Water Hammer Eliminator



914

The Techniflex Corporation of Port Jervis, New York, has announced the release of its newly designed Water Hammer Eliminator for domestic and small commercial piping. Units are currently available with ½" and ¾" male I.P.T. connections.

From a design standpoint the Techniflex unit takes advantage of the resiliency of seamless convoluted metal hose in combination with the compressability of the air pocket. The unit is made of brass and bronze components and provided with an outer bronze braid covering for reinforcement with a resultant burst pressure of 900 pounds per square inch minimum.

Automatic Softener Controls

915

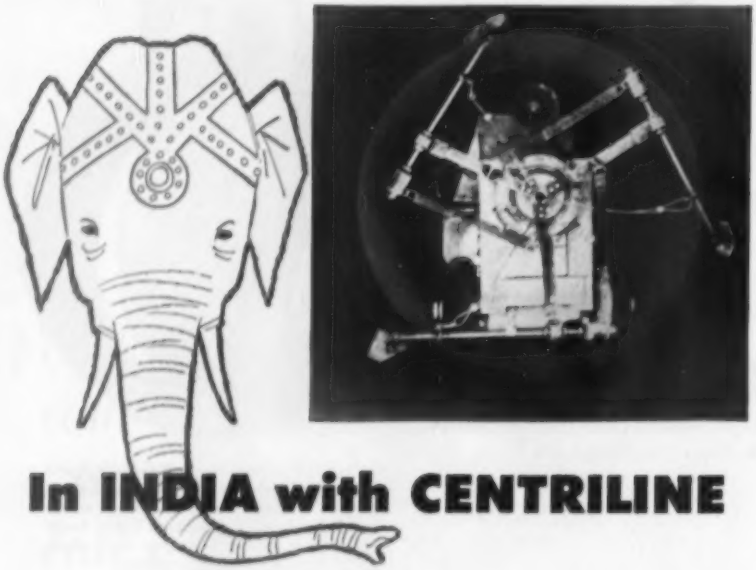
Graver Water Conditioning Co., New York, N. Y., has developed a new, automatic control system for dual tank zeolite softeners.

This system is part of a completely pre-engineered zeolite softening unit including electrical control panel, flow meter, automatic multi-port valve, zeolite softeners, brine measuring tanks and connecting lines.

The outstanding feature of this system is a new, electrical control panel containing a series of relays and a multiple-cam timer which initiate periodic, timed regeneration of the softeners.

Incoming raw water is measured by an inlet water meter register. When a predetermined volume of water has passed through the meter a contact automatically closes beginning the regeneration circuit. One relay is immediately locked in

(Continued on page 128A)



In INDIA with CENTRILINE

On the coast of India, the Burma-Shell Refining Company has used the Centriline process on over 21,000 feet of sea-water cooling pipe. Through Centrilining, a cement-mortar lining is centrifugally sprayed on the pipe walls. Corrosion and tuberculation are eliminated . . . pumping costs are lowered . . . flow is increased . . . maintenance becomes negligible . . . and pipe life is extended indefinitely. This particular project in Bombay called for the Centrilining of 32" I.D. and 36" I.D. new steel pipe with 5/16" lining. But Centrilining works wonders in old pipes as well—with a minimum of surface traffic interruption. Proof of the pudding is in our files—the ever increasing number of repeat contracts from municipalities, industries and contractors. Why not follow their lead. Look to Centriline to rejuvenate *your* water supply systems.

Lummus Company, India, was engineer and constructor on this project. Asiatic Petroleum Corp. was buyer for the owner.

CENTRILINE CORPORATION

A subsidiary of the Raymond Concrete Pile Company

140 CEDAR STREET
NEW YORK 6, N. Y.

Branch Offices in Principal Cities of the United States and Latin America

• CEMENT-MORTAR LINING OF PIPES IN PLACE •

Salem got the "Big 3"

Will your city?

Out here in Ohio, Salem wanted a 20-inch supply line that would *last a 100 years or more,* be *strong enough to be virtually shatter-proof,* and give them *sustained high carrying capacity.*

They picked Price Pipe, because it gave them *every one* of the "Big 3": *long life, great strength* and *sustained capacity.*

Rochester, N. Y. picked Price Pipe for the same reasons. So did Dayton, Ohio, Saginaw, Michigan and many more.

Will your new water line meet all three requirements?

If you want the best pipe today's engineers can design, specify Prestressed Concrete Steel-Cylinder Pipe.

Tell your consulting engineer to check with our engineering department for sizes, weights, tests and laying information.

Price Brothers Company

1856 East Monument Ave. • Dayton 1, Ohio

Member American Concrete Pressure Pipe Association

Concrete Pressure Pipe for Water Supply, Subaqueous, Pressure Sewer and Culvert Installations

while another is locked out so that only one softener will be regenerated at a time. This relay in turn starts the timer motor which rotates a cam shaft through a series of switches each of which positions the multi-port valve for successive backwash, inject-displace, rinse and service operation.

Automatic Data Loggers For Water Systems

916

Fischer & Porter Co., Hatboro, Pa., has developed modern automatic data logging equipment for use in centralized control stations that is said to save municipal water works systems thousands of dollars.

The automatic system makes it possible for readings from instruments in widely separated points in the water system to be transmitted instantaneously and continuously to the central station for control, statistical, or accounting purposes.

Provision can be made for supervisory control of remotely located pumps. This enables a water works operator to start and stop a complete pumping station from a central location and receive positive confirmation of his action.

Readings transmitted include reservoir and tank level, pump and pipeline pressures, and flow rates. Practically any variable which can be translated into an electrical signal can be handled.

MECHANICAL JOINT
TAPPING VALVE AND SLEEVE
MH
A. W. W. A.
OR
UA & FM

FOR EASY, QUICK, PERMANENT INSTALLATION

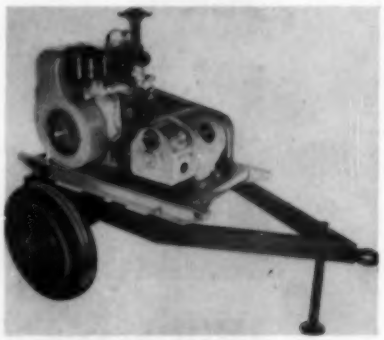
This is our widely used M&H Tapping Valve and Sleeve, with Mechanical Joint connections. The only assembly tool needed is a ratchet wrench. The split sleeve has Mechanical Joint ends, and the longitudinal top and bottom joints are the same type. It may be installed quickly by unskilled workmen. One end of the valve is flanged for bolting onto the sleeve, the other end of the valve is special type Mechanical Joint for connection (first) to the tapping machine and (second) to the mechanical joint pipe line.

Designed for tapping a main under pressure to take off a branch larger than corporation cock size. Valves furnished in accordance with A.W.W.A. specifications, or UA&FM with or without bonnet flange for indicator post, or with rising stem for use in manhole or valve pit. For details, wire or write

M & H VALVE AND FITTINGS COMPANY, ANNISTON, ALABAMA

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION.

Gasoline Driven Generator

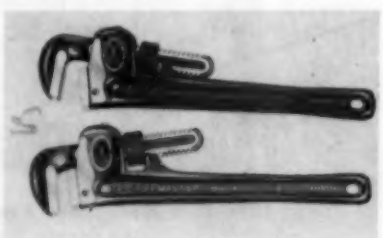


917

Maginniss Power Tool Company, Mansfield, Ohio, has announced the development of a new heavy duty Hi-lectric Multi-purpose gasoline engine driven generator, especially suited for economical use under full load for long periods of time with maximum engine life.

The new unit is powered by a 12 hp, 2 cylinder, air cooled engine which provides full generator output at 2,200 engine rpm. Because the engine operates steadily at well below its top rated speed, power plant maintenance and repair costs are said to be reduced substantially. The unit will provide 3,500 watts of power and is furnished on a skid base mounted on a 2 wheel rubber-tired trailer for over-the-road towing.

New Heavy Duty Wrench



918

The Erie Tool Works, Erie, Pa., has just been issued a patent on a heavy-duty wrench with a radically different spring. The spring

• If interested in equipment or literature mentioned below, mail a

is Z-shaped and notched to fit under a pin running transversely through the wrench housing, the pin acting as a pivot. The spring gives a positive double action in the wrench operation; the bite and release are much easier and more rapid, and ratcheting is improved. The wrench will be added to the "Pipemaster" line.

In the photograph the upper wrench shows the position of the jaw when no pressure is exerted on the handle. The lower picture shows the jaw position when full pressure is on the handle and the jaw biting on pipe. Release of pressure on handle allows the jaw to spring back, releasing the wrench, yet leaving the jaws in position to be replaced on the pipe.

The new wrench is available in 6" through 48" sizes with straight handles, and 8" through 18" in the offset type.

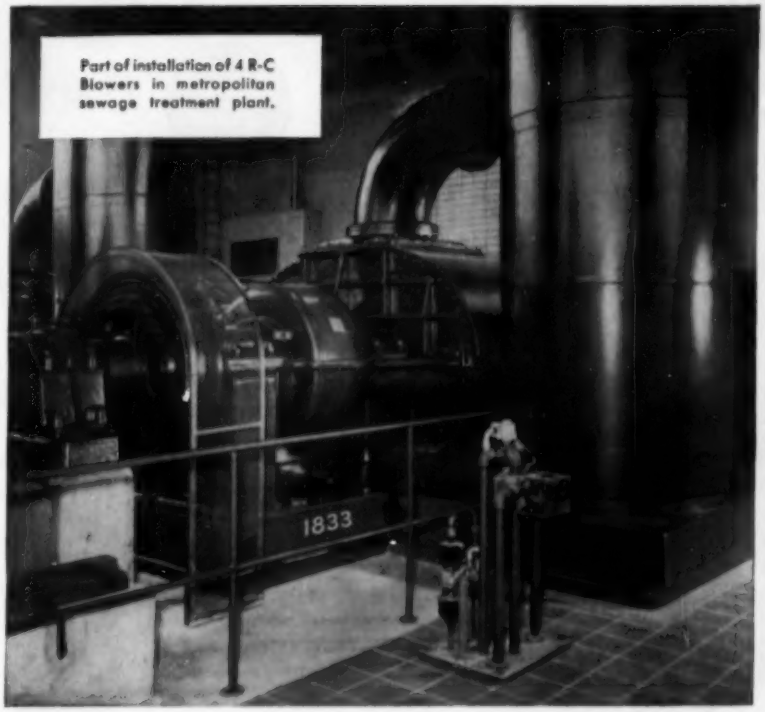
Filter Control System Console

919

Builders-Providence, Inc., Division of B-I-F Industries, Providence, R. I., has announced the Pneumaster Console, a streamlined housing for filter gauges, valve-operating switches and valve position indicators for the Pneumaster Filter Control System, an integrated "system," comprising complete Builders filtration control equipment for efficient operation of gravity filters.

The Pneumaster Console meets the most exacting needs of the modern filter plant by using precision air receivers and receiver type filter gauges which receive

(Continued on page 130A)



Part of installation of 4 R-C Blowers in metropolitan sewage treatment plant.

No failures in volume or pressure with R-C Rotary Blowers

CHECK THE "BIG 4" ESSENTIALS

1. Accurate volume at required pressure
2. High efficiency—low operating cost
3. Low maintenance cost —low down time
4. Freedom from oil or oil vapor contamination

Check your present blowers and if they don't measure up, it may be an economy to replace them with modern R-C equipment.

In any capacity, from 5 cfm to 50,000 cfm, R-C Rotary Positive Blowers faithfully and accurately deliver their rated volumes and pressures. That's one most important reason for their wide use in sewage treatment plants where positive control of these two basic characteristics is essential.

But there are other reasons, too, for the selection of R-C Blowers wherever air must be moved for industrial processing. Check the accompanying list of "BIG 4" essentials and you'll see why sturdy R-C Rotary Positive Blowers have long been "standard" with thousands of purchasers for widely varying applications.

If you have a job of moving air or gas, call the R-C engineer. With Rotary Positives, Centrifugals and the new Spiraxials, he can give you unbiased counsel and suggestions. Or, write us about your needs, and we'll send informative bulletins on equipment for new installations or replacements.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
155 Mount Ave. • Connersville, Indiana

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pH Correction

Ease of Operation

Bacterial Removal

Turbidity Removal

Economy

Rapid Floc Formation

Color Removal

Taste and Odor Control

Softening

Manganese and Silical Removal

Do You Get These Advantages With the Coagulant You are Now Using?

Users of Ferri-Floc enjoy these advantages—whatever your specific water treatment problem may be, you can depend on Ferri-Floc to do the job adequately, efficiently and economically—A partially hydrated ferric sulfate, Ferri-Floc is a free flowing granular salt which can be fed, with a few modifications, through any standard dry feed equipment. It is only mildly hygroscopic, thereby permitting easy and safe handling as well as storage in closed hoppers over long periods of time.

TENNESSEE CORPORATION Ferri-Floc FERRIC SULFATE

Water Treatment

Ferri-Floc coagulates surface or well waters, and it aids taste and odor control. It is effective in lime soda-ash softening, and is adaptable to treatment of practically all industrial water or wastes.

Sewage Treatment

Ferri-Floc coagulates waters and wastes over wide pH ranges. It provides efficient operation regardless of rapid variations of raw sewage, and is effective for conditioning sludge prior to vacuum filtration or drying on sand beds.

SULFUR-DIOXIDE HIGHEST QUALITY SO_2

Sulfur-Dioxide

SULPHUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULFATE

Copper Sulfate

COPPER SULPHATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

Free New Booklet!

Let us send you without charge a 38-page booklet that deals specifically with all phases of coagulation.
Send postal card to—

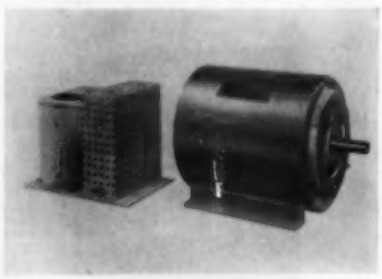
TENNESSEE CORPORATION

617-629 Grant Building, Atlanta, Georgia

and accurately indicate filter flow and head loss data.

The Pneumaster Console provides a factory assembled unit with the following advantages: accuracy and sensitivity obtained by use of precision indicating gauges; easy, inexpensive installation requiring only a few simple connections; quick report back of actual valve position achieved by precision valve position indicators; functional design of component gauges, indicators, controls at convenient height allows operator to "see-over" for backwashing operations; and minimum maintenance by elimination of cables, cords, pulleys and counterweights from the pipe gallery.

Small Mobile Power Unit Delivers 10 KW



920

Star-Kimble Motor Division, Bloomfield, N. J., has developed the "Mo-Bil-Ac," a new portable source of AC power that delivers up to 10 KW at 110-120 volts and greatly extends the use of power tools and motor driven machinery in locations away from power lines.

The big feature of the Mo-Bil-Ac is its compactness and light weight. The 2-pole alternator, which forms one half of the two-part unit, may be mounted under the vehicle hood and driven by a V-belt from a sheave on the crankshaft in front of the fan pulley, or by a power take-off.

The other half of the system is the regulator, a static unit of the magnetic amplifier type with a selenium rectifier to provide alternator excitation. Measuring only 10 x 6 x 7 inches, the regulators' operating characteristics are carefully matched with those of the alternator for optimum performance.

New Subscription Order Card

Water & Sewage Works

185 NORTH WABASH AVE. CHICAGO 1, ILL.

Gentlemen:

Please enter my new subscription to WATER & SEWAGE WORKS for the period checked below:

☐ Three Years—$6.00 ☐ Two Years—$4.50 ☐ One Year—$3.00

Above rates are for U.S.A. and Canada. Add $1.50 per year for other countries.

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929	930	931	932	933	934	935
936	937	938	939	940	941	942

IF YOU WISH TO RECEIVE FURTHER INFORMATION ON PRODUCTS ADVERTISED OR REFERRED TO IN THE ARTICLES, OF THIS ISSUE—LIST THE PAGE AND ITEM BELOW.

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***ITEMS LISTED NOT SERVICED AFTER NOV. 30, 1955**

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NEW YORK 14, NEW YORK

W&SW

Manufacturers' News

Wolfe Named Manager Of ACIPO Chicago Office

American Cast Iron Pipe Company, Birmingham, Alabama, has announced the appointment of Warren W. Wolf as manager of the company's Chicago Sales office, succeeding Earl N. Mattson who retired in July 1955.

Mr. Wolfe has been connected with ACIPO for the past 26 years, the last twelve of which were spent in the Chicago office. He began in the Engineering Department in Birmingham in June, 1929. He was transferred to the Kansas City Sales office in 1940, and to the Chicago office in 1943.

Born in Talladega, Alabama, Mr. Wolfe was educated at the Clarksville, Tennessee, High School and at the University of Tennessee. He holds membership in the Alpha Tau Omega Fraternity and the American Water Works Association.

Bulkley, Dunton Adds New Representative

Bulkley, Dunton Processes, Inc., of New York City, has announced the appointment of Backus & Spencer of Cleveland, Ohio, to handle the complete line of Bulkley, Dunton equipment.

The New York firm made the move as part of a planned program to give more intensive sales and service coverage to American industry.

According to the Company, the Backus & Spencer organization will handle all industries in the State of Ohio north of Columbus.

Foxboro Establishes Ten Regional Sales Divisions

The Foxboro Company, of Foxboro, Mass., has announced the establishment of ten regional sales divisions, with territories arranged for maximum service to industrial instrument users. Administered by Mr. H. O. Ehrisman, newly appointed general sales manager, and Mr. J. J. Burnett, field sales manager, the new regional structure will permit full utilization of the company's 48 branch offices in serving the needs of industry.

Geographically, the new sales regions are effectively integrated with Foxboro's newly expanded service

(Continued on page 132A)

Hardinge CLARIFIERS for circular tanks

Two Hardinge 100'-diameter, center-column final clarifiers at the municipal sewage disposal plant in York, Pennsylvania. (Albright and Friel, consultants)

Hardinge Clarifiers and Thickeners are being used in:

- SEWAGE TREATMENT PLANTS for primary and final clarification and sludge thickening.
- INDUSTRIAL WASTE TREATMENT of all types.
- WATER TREATMENT, industrial and public.

A wide selection of sizes and arrangements is offered:

- Normal duty and "Auto-Raise" heavy duty mechanisms.
- Beam, truss and center-pier supported units.
- Side feed and under feed.
- Spiral and segmented rakes.
- Mechanical, hydraulic or electrical overload protection.

Detailed specifications for all types and sizes are available upon request. Bulletin 35-D- 15.

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

and manufacturing facilities, new branch factories having been constructed in Dallas, Pittsburgh and San Leandro, California, during the past year.

The ten regional sales offices and regional managers are: New England, H. H. Michelmore; New York, E. R. Huckman; Philadelphia, J. B. Deaderick; Pittsburgh, A. H. Shafer; Atlanta, E. W. Prendergast; Cleveland, H. L. Lee; Chicago; J. J. Connelly; Dallas, E. L. Stark; Houston, L. W. Parten; and San Francisco, R. E. Rogers.

Fulton Named Cincinnati Manager By Allis-Chalmers

Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin, has announced the appointment of R. B. Fulton as manager of the Cincinnati district for the general machinery division.

Mr. Fulton, a representative in the Cincinnati district since November, 1951, succeeds W. F. Daly, who retired June 30, 1955, after over 30 years service with Allis-Chalmers.

After joining the company in 1943, Mr. Fulton has represented the company in the Pittsburgh and Detroit districts before being transferred to Cincinnati.

Fischer & Porter Names 4 Vice Presidents

Fischer & Porter Co., Hatboro, Pa., has announced the promotion of four managers to vice presidents in charge of their respective divisions, bringing the number of vice presidents to six.

The new appointments are: Robert A. Stern, vice president, Data Reduction & Automation Division; Louis H. Aricson, vice president, International Division; Nathaniel Brewer, vice president, Research; and Edward J. Querner, vice president, Manufacturing.

The other vice presidents are Seymour Blechman, vice president, Sales, and Jack C. Boonshaft, vice president, Engineering.

Badger Meter Promotes Abrams

The Badger Meter Mfg. Co., Milwaukee, Wisconsin, has announced the appointment of Norman H. Abrams as Southwest District Sales Manager.

Abrams, who is a graduate of Texas A & M, started with Badger Meter in 1926. Previously he had been with the St. Louis and San Francisco Railroad and Texas Power and Light Co.

A registered professional engineer, Abrams is also affiliated with the Shrine, the Rotary Club and is a member of the American Water Works Association.

Crane Co. Promoted Lindholm

Crane Co., Chicago, Ill., has announced that George G. Lindholm, manager of the Chicago branch since 1948, has been appointed manager of the company's valve and fitting department at its general office, Chicago.

He succeeds F. J. Wilkey who has been named special representative of Crane Co.'s industrial sales division. Mr. Wilkey has headed the valve and fitting department since 1944.

Thomas D. Kelly has been appointed manager of the Chicago branch to succeed Mr. Lindholm. He has been manager since 1953 of the company's Cleveland branch.

Mr. Lindholm has been associated with Crane Co. since 1919. He was assigned to the general office, the Chicago Works, the former Evanston

ONE WAY
TO HELP CONSERVE YOUR WATER SUPPLY
WATER is becoming more scarce, more expensive to obtain, treat, pump and deliver.
CONSERVATION starts with the efficient handling and delivery of water supplies — including meters, meter setting and testing equipment.
FORD
THE new Ford Catalog No. 56 is a water man's "bible". It not only pictures and lists the latest in meter servicing equipment, but it contains diagrams and much helpful data for the express purpose of conserving water through more efficient use of meters. It is available on request. Send for your copy today.
FORD
FOR BETTER WATER SERVICES
THE FORD METER BOX COMPANY, INC. Wabash, Indiana

and Northwest side branches, Louisville, railroad sales and the Detroit branch before being named assistant manager of the Chicago branch in 1944.

Smolensky Valve Appoints 4 New Representatives

Smolensky Valve Company, Bedford, Ohio, has announced the appointments of four new representatives.

Mr. Robert A. Shuey, Jr., 4405 Highland Drive, Dallas, Texas, will cover the State of Texas.

Mr. R. W. Jordan, 53 W. Jackson Blvd., Chicago, Illinois, will represent the company in the State of Illinois.

Mr. Floyd H. Boyer, P.O. Box 1751, Denver, Colorado, will cover the state of Colorado.

Sellers Company, 815 Loraine Ave., Ardmore, Pennsylvania, will act as the company's representative in the eastern half of Pennsylvania.

Rhodia Appoints New Representative

Rhodia, Inc., New York, N.Y., has announced the appointment of Burhans-Sharpe Company, Seattle, as sales and service representative for its line of "Alamask" industrial reodorants in the Pacific Northwest.

Burhans-Sharpe specializes in chemical engineering for industry throughout Oregon, Washington, Montana, Idaho, Wyoming, Alaskan Territory and Hawaii. Its headquarters are 1743 First Avenue S, Seattle 4, Washington.

De Laval Names Ecuadorian Representative

The De Laval Steam Turbine Company, Trenton, N. J., has announced the appointment of L. Henriques & Cia., Guayaquil, Ecuador, as their exclusive representative in Ecuador. L. Henriques & Cia. will handle De Laval centrifugal pumps, steam turbines and steam turbine-generators, De Laval IMO pumps and other products manufactured by De Laval.

Hoeppner Named Manager Of Peerless Pump San Francisco Branch

Peerless Pump Division, Food Machinery and Chemical Corpora-

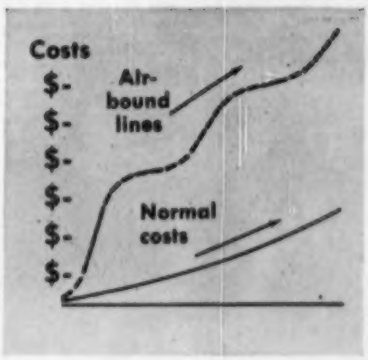
(Continued on page 134A)

COST CUTTING

HOW TO CUT PUMPING COSTS

• When air lodges in high spots, it cuts the effective area of pipe, creates a friction head, lowers pumping capacity . . . and may cause water-hammer.

Simplex Air Release Valves end these troubles. They vent air automatically to eliminate binding, increase efficiency, cut pumping costs. Simple, rugged 2" size, for up to 250 psi., costs you little, quickly pays for itself! BULLETIN 1204



HOW TO PREVENT PIPELINE COLLAPSE

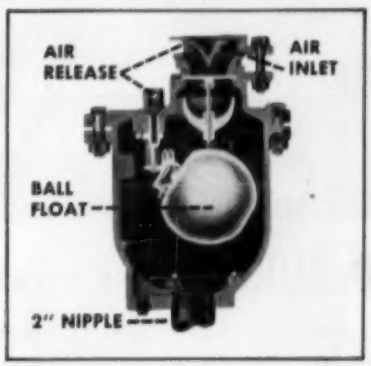
• A break in the line or a quickly opened valve often releases water at terrific velocity. Internal pressure falls below atmospheric. Thin-walled pipelines collapse!

Simplex Air Inlet Valves quickly admit air, prevent a vacuum, protect lines from collapse. They also vent air when lines are being filled to stop binding, increase efficiency. Standard 4" to 10" sizes. BULLETIN 1202

Pipeline collapse due to vacuum

HOW TO IMPROVE YOUR SYSTEM

• Here's a new way to increase pumping efficiency and prevent pipeline collapse . . . at low cost. One unit, Simplex Type AV Valve, does 3 jobs. It admits air to break vacuums, prevents pipeline collapse. Releases air to prevent binding, cuts pumping costs. Vents large volumes of air when system is filled . . . saving you the cost of buying large valves for this limited use. Dimensions only 11⅝" x 16¼". Easy to install . . . one 2" connection. BULLETIN 1205



New combination inlet-release valve

WRITE for Technical Bulletins! Simplex Valve & Meter Company, Dept. WS-9, 7 E. Orange St., Lancaster, Pa.

Accurate instruments and controls since 1904

SIMPLEX®

VALVE AND METER COMPANY

Today's Facts on Modern
SEWAGE EJECTION

Blackburn-Smith Mfg. Co.
51 Garden Street, Hoboken, N. J.
I want to know how I can get better sewage ejection at lower cost.
Name.....
Company.....
Address.....
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Features of BLACKBURN-SMITH EJECTORS
Switches operated automatically by float and electrical controls.
Snap-action valves controlled automatically, pneumatically and by float. Electrode controls.
Compact . . . motor compressor assembly and controls in "one package" unit.
Steel construction. Welded steel pots.
Simple piping for air, water.
No clogging screens, impellers, shredders.
No messy pump cleaning. Sanitary.
Unfailing, dependable operation.

BULLETIN S-50
for look-ahead municipal engineers

Get the facts you want on how to eliminate costly, complex piping for air and water, messy, unsanitary screens, impellers, shredders, expensive pump cleaning . . . in short, the facts on simple, dependable, economical, clean Blackburn-Smith Ejectors. Valves and switches are controlled automatically for unfailing operation by electricity, by floats, and by pneumatic action. Learn how simple, compact, and inexpensive they are to install, operate, and maintain compared to complicated systems. *Get today's facts today—Send the coupon in now!*

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FROM WATER TO SLUDGE...
THE NON-LUBRICATED VALVES FOR ALL SEWAGE SERVICES!

DeZURIK EASY-OPERATING PLUG VALVES

are the *only* valves with the rubber-faced eccentric plug that closes down *tight* on water or sludge. Sewage "grease" can't pile up on the valve seat; there's no place for it to lodge inside the valve.

On any line—from sludge to solvent to water—DeZurik Easy-Operating Plug Valves are the non-lubricated, non-leaking, non-binding valves you've been looking for. Sizes from ½" to 20"; manual or remote operation. See us in BOOTH 83-84 at Atlantic City, or write for complete details.

DeZURIK SHOWER CO. SARTELL, MINNESOTA

tion, Los Angeles, Calif., has announced that C. Scott Hoeppner has been named Branch Manager of the new factory sales office recently opened at 461 Market St., San Francisco.

Recognized for over 15 years in the Western pump industry, Hoeppner has served since 1948 in sales engineering capacities with the Peerless organization.

Diamond Alkali Renames Memphis Branch Office

Diamond Alkali Company, Cleveland, Ohio, has announced that the Memphis Branch Sales Office of the company at 1381 Heistan Place will be known henceforth as the Southeastern District Office.

In making the announcement, the company said the newly-designated name has been adopted because it is more fully in keeping with the increased territorial coverage presently handled by Diamond's Memphis-located organization. With the company's new caustic soda plant at Muscle Shoals, Alabama, now in full production, the office will now cover the entire southeast.

Burnett Gen. Manager Johns-Manville Celite Div.

Johns-Manville Corp., New York, N. Y., has announced the appointment of Clinton B. Burnett as General Manager of the Celite Division.

Mr. Burnett succeeds Arthur S. Elsenbast, who retired on July 31, 1955.

Mr. Burnett, who continues as Vice President of Johns-Manville Products Corp., was Director of Engineering before his appointment as Assistant General Manager of the Celite Division in July 1954. He has also been Production Manager of the Building Products Division and Operating Manager of the Kansas Ordnance Plant during World War II. Mr. Burnett joined Johns-Manville in 1931 at the company's plant in Waukegan, Ill.

American Wheelabrator Changes Name

American Wheelabrator and Equipment Corp., Mishawaka, In-

diana, has announced that it has changed its corporate name to Wheelabrator Corporation. The move does not involve any alteration in the ownership, management, or operation of the company, which manufactures blast cleaning equipment, dust and fume control equipment, and foundry equipment.

Simplex Appoints Gerlitz V.P. In Charge Of Sales

Simplex Valve & Meter Company, Lancaster, Pa., has announced that Frank E. Gerlitz has been appointed to the position of vice president in charge of sales. In his new capacity, Mr. Gerlitz will be responsible for stepping up sales of Simplex products and services.

Gerlitz started with Simplex in January 1940 as a sales engineer, was promoted to assistant sales engineer in June 1945; made sales manager in April 1947 and appointed to his new capacity in July 1955.

He is a graduate of Bucknell University, holding a bachelor's degree in Civil Engineering, is a member of the AWWA, FSIWA, and ASCE.

Simplex Appoints New Sales Engineer

The Simplex Valve & Meter Company, Lancaster, Pa., has announced the appointment of Mr. Hugh J. McNelis as sales engineer for their Chicago, Ill., office. He came to Simplex in January 1952 as a service engineer for their Philadelphia, Pa., office.

Working in conjunction with Mr. A. F. Barron, Sales Representative, his territory will include Northern Illinois, Northern Indiana and Western Michigan.

Crane Co. Promotes Hunter

Crane Co., Chicago, Ill., has announced that R. G. Hunter, manager of the Tulsa, Okla., branch since 1946, has been appointed dis-

(Continued on page 136A)

ON WATER CONDITIONING CONSULT AMERICAN ... first

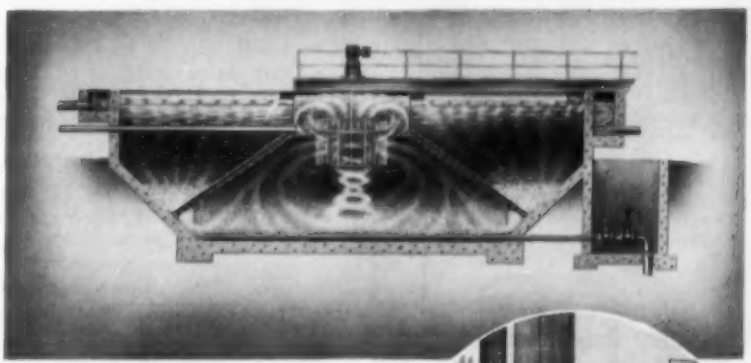
advanced engineering is the important factor in

AMERICAN

water conditioning service

• WASTE WATER TREATMENT FOR SALVAGE?

• WASTE WATER TREATMENT TO PREVENT POLLUTION?



CONSIDER AMERICAN THREE-STAGE REACTORS

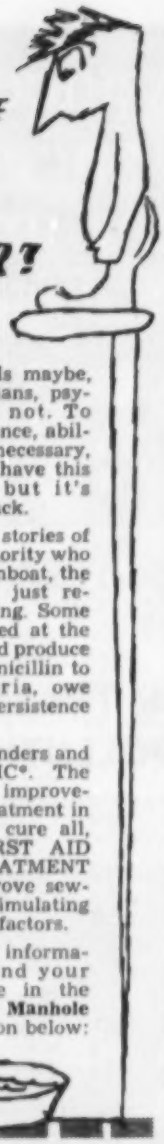
More and more attention is being given to waste water not only from the point of view of preventing stream pollution but also from the economy angle as well. Each industrial plant presents a particular problem—due to the quantity of water and the waste materials involved. Salvage of the water itself, is becoming important in many sections of the country. American three-stage Reactors are handling the problem of waste water for industry of many kinds. Consult with American Engineers about the application of American Reactors to your problem. You'll benefit by American's more than 52 years of experience in water treatment. Send for Bulletin 500.

SERVICE SINCE 1902 — TO THE INDUSTRY

AMERICAN Water Softener COMPANY

INCORPORATED

FOURTH AND LEHIGH AVENUE • PHILADELPHIA 33, PENNSYLVANIA



is EXPERIENCE the best TEACHER?

For some animals maybe, but for some humans, psychologists think not. To profit from experience, ability to evaluate is necessary, and some humans have this essential trait, but it's slightly out of whack.

History is full of stories of the vocal early minority who were agin' the steamboat, the electric light, and just recently, atom splitting. Some of those who scoffed at the idea that mold could produce a substance like penicillin to kill disease bacteria, owe their lives to the persistence of others.

Take off your blinders and examine BIONETIC°. The first new rational improvement in sewage treatment in fifty years. Not a cure all, BIONETIC is FIRST AID TO WASTE TREATMENT and works to improve sewage processes by stimulating various biological factors.

Send for FREE informative literature and your FREE certificate in the **Loyal Order of Manhole Sniffers.** Mail coupon below:

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Reliance Chemicals Corp.
P. O. Box 6724 Houston 5, Texas

—— I want my membership certificate in the LOYAL ORDER OF MANHOLE SNIFFERS. Also please send me FREE copies of the following BIONETIC Tech Talks:
—— Sludge Digestion
—— Cleaning Collection Systems
—— Care of Trickling Filters
—— Odor and Grease Removal

Name _____
Address _____
City and State _____

*Reg. TM: Reliance Chemicals Corp. Applies only to a specific method of manufacture of preserved cultures of beneficial micro-organisms of uniform potency that are field tested in waste treatment plants.

tract manager with headquarters at Dallas.

He succeeds J. A. McMurry who has been named Director of Crane Co. branches with headquarters at Chicago.

Mr. Hunter has been associated with Crane since 1925 when he joined the company at its Springfield, Ill., branch.

Five Field Changes For Diamond Alkali

Diamond Alkali Co., Cleveland, Ohio, has announced the following five assignment changes in the company's field sales and service organization:

Robert R. Wood, a member of Diamond's New York sales staff since January, 1949, has been promoted to the position of special staff assistant in the Sales Department at Cleveland.

His successor at New York is C. Robert Powell, who has been transferred from Cincinnati, where he is being succeeded by Charles H. Gillespie as sales representative in the Louisville area.

Charles B. Kayser, on Diamond's Cincinnati sales staff since May, 1948, will now represent the company at Columbus, with headquarters at Columbus, Ohio.

Louis P. Lambros, formerly of Diamond's Central Order Department at Cleveland, has been named to succeed Mr. Kayser in Cincinnati.

Ridge Tool Appoints Rowe Ass't Sales Manager

Ridge Tool Company, Elyria, Ohio, has announced the appointment of D. H. Rowe as Assistant Sales Manager. In this newly created position, Mr. Rowe will assist Sales Manager W. L. Parcell in carrying on the company's national sales, advertising and sales promotion program.

Before joining Ridge Tool, Mr. Rowe spent four years as Advertising Manager for the Cleveland Worm and Gear Company and its affiliate, the Farval Corporation. Prior to this, he served as Associate Editor of New Equipment Digest. During World War II, Rowe was a training director for Jack and Heintz, Inc., and at war's end he resumed his activities in sales and advertising.

Tough and Strong LASTS EXTRA LONG

KONIK metal beats the rigors of a tough culvert life—it resists rust and fights element corrosion. The Continental open hearth steel plus copper, nickel and chromium does it. These sheets are made especially for culvert use because they stand more rough abuse. Continental Steel Corporation, Kokomo, Indiana.

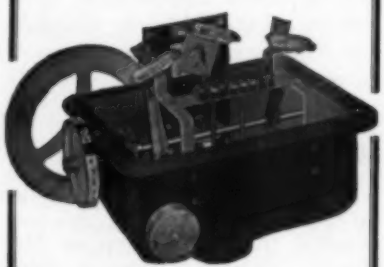
ASK TO SEE THE KONIK CULVERT METAL WARRANTY

Continental culvert distributors are glad to show the KONIK warranty . . . and the certified analysis that assures the longer culvert life of KONIK metal.

CONTINENTAL STEEL CORPORATION

FENCE • BARBED WIRE • POSTS • NAILS • ETC.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION

HEALY-RUFF COMPANY

783 HAMPDEN AVE., ST. PAUL 4, MINN.

Literature & Catalogs

Gas Storage in Hortonspheres

921

Chicago Bridge & Iron Company, Chicago, Illinois, has available for distribution reprints of the six-page article entitled, **"Greater Gas Storage in Hortonspheres,"** which discusses the advantages of using high strength materials in the fabrication of spherical pressure vessels. The impact and hydrostatic pressure tests for USS T-1 are described. Included are volume, diameter, pressure relationship charts comparing the commonly used premium steels.

Propeller Type Meters

922

Builders-Providence, Inc., Providence, R. I., has printed a twelve-page color bulletin on its complete line of **Propeloflo Meters,** a direct-reading, propeller type instrument for metering water and other liquids.

The bulletin, divided into major sections on typical specifications, types, typical accuracy curves, ranges, installation dimensions, and pressure loss chart, also contains subheadings on the electrically- and electro-mechanically-operated totalizer, indicator, recorder. General information on the description and operation of Builders Propeloflo Meters are also included.

Occupational Safety Services

923

The National Safety Council, Chicago, Ill., has just released the council's **1955 Occupational Safety Services Guide.**

In the service guide, company safety men will find not only the tools they need to build their plant safety programs, but also the training aids available for instructing supervisors and workers.

For the safety man, the 68-page guide provides a list of Council periodicals, newsletters and a complete library of technical and administrative publications covering all phases of occupational accident prevention. Information on the sub-

(Continued on page 138A)

Butterfly Sluice Valves

Save space . . . Fast, easy operation . . .
Save installation costs . . . Drop tight!

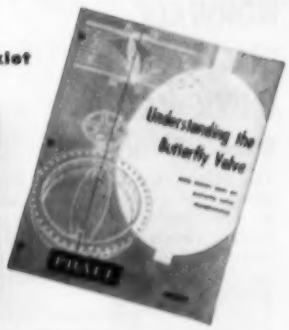
No "double head room" needed. The 90° rotation of the valve disc takes place entirely within the valve body . . . no additional head room is needed. Henry Pratt Butterfly Sluice Valves are the answer to the problem of valving a large flow in a minimum space.

Fast, easy operation. Even the largest of these valves can be opened or closed by one man in a few minutes.

Full 90° closure into Rubber Seat. The disc is slightly larger than the inside of the rubber seat and thus actually displaces the rubber when closed. The ratio of seat thickness to disc indentation insures drop-tight shut off and avoids permanent set. The seats are secured in the valve body by removable keeper segments.

Simple, low cost installation. The entire valve is installed in one piece. There are no guide-ways to set, and thus there is no possibility for subsequent warpage to prevent tight shut-off.

Send for informative booklet



HENRY
PRATT

RUBBER SEAT
Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

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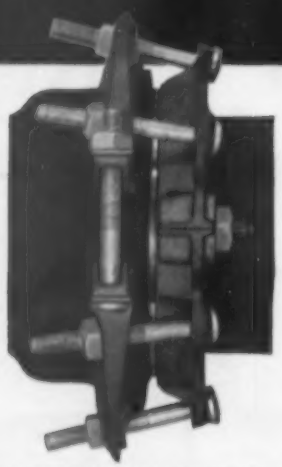

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jects covered in the basic and advanced courses of the Council's Safety Training Institute are also included.

Acidizing Service For Water Wells

924

Dowell Incorporated, Tulsa, Oklahoma, has available a 4-page bulletin on **Dowell Acidizing Service For Water Wells.**

The bulletin gives a complete description of the service; how the company analyzes the well problem; and the complete methods of treatment. The last page lists 3 complete case histories listing before and after well pumpage and method of treatment.

Sequence Timing Control

925

Minneapolis-Honeywell Regulator Company, Philadelphia, Pa., has released a data sheet that describes two systems for obtaining **Sequence Timing Control.**

These systems, as presented in the data sheet, are used in water treatment plants, chemical and food processing plants, paper and textile mills to pace chemical feeders and other equipment. They present a method for operating processing equipment in accordance with specified increments of total flow or weight measurements.

Control Systems For Filtration Plants

926

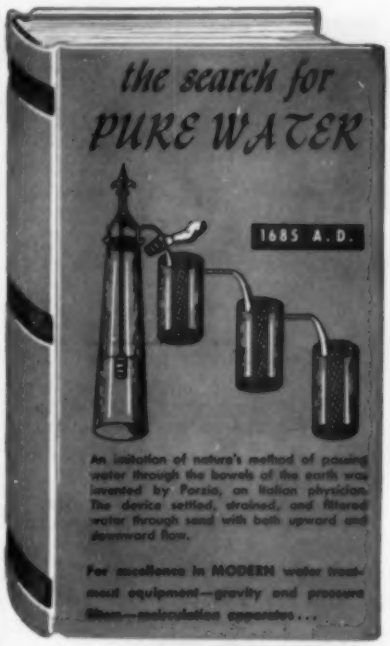
Hagan Corporation, Pittsburgh, Pa., has released a 12-page bulletin on **Hagan Control Systems For Filtration Plants.**

The bulletin, by means of photographs, flow diagrams and keyed text describes how the Hagan control systems for filtration plants are individually engineered to meet the specific requirements of each plant. A complete description of the equipment used in the control systems and a short paragraph on the Hagan Engineering Service are also included.

Zinc Controls Corrosion

927

American Zinc Institute, New York, N. Y., has just published a 32-page illustrated booklet that dis-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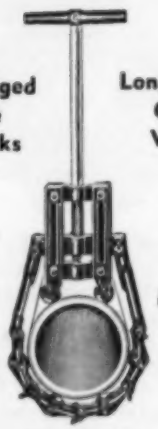

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cusses **How Zinc Controls Corrosion.**

The booklet describes the many ways zinc lengthens the life of steel products, and reduces maintenance costs. Drawings, charts, and photographs together with brief comments present the corrosion control characteristics of zinc coatings, zinc pigments, and zinc anodes.

V-Belt Drives

928

Maurey Manufacturing Corp., Chicago, Ill., has just released a new 3-color, 24-page catalog that describes the complete line of **Maurey Mor-Grip V-Drive Belts.**

According to the catalog the multiple line consists of super, steel cable, open end and hexagon V-belts as well as V-link belting. Each type of V-belt is completely described as to its construction and applications.

Asbestos-Cement Pipe Cutter

929

Spring Load Manufacturing Corp., Seattle, Washington, has available a data sheet on the new model of the **Spring Load Asbestos-Cement Pipe Cutter.**

The descriptive, illustrated data sheet includes parts and price list on the new cutter. According to the new literature the tool weighs approximately 12 pounds, reduces cutting time by 50 percent, and gives a clean cut within one inch of the end of any asbestos-cement pipe.

Motorpumps

930

Ingersoll-Rand, New York, N.Y., has just released a new 24-page **Motorpump** bulletin.

The bulletin covers the company's entire line of close-coupled Motorpumps from ¼ to 75 horsepower sizes for delivery of 5 to 2800 g.p.m.

Designed to make it easy to select the correct size and model, the bulletin contains a visual and concise index that shows the basic classifications of the pumps covered with their specifications. The next three pages highlight the advantages of the Motorpump and point up its design features.

On the following pages each class of pump is explained and illustrated in detail. In the heavy-duty range a 75 hp pump has been

(Continued on page 140A)

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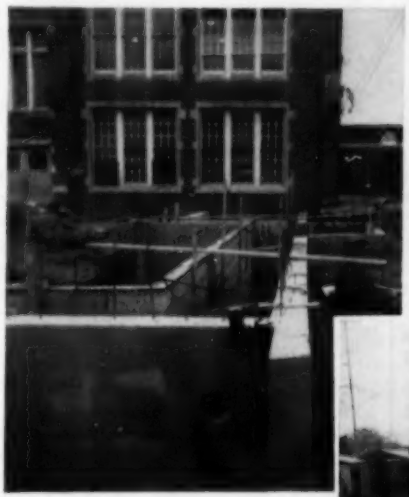

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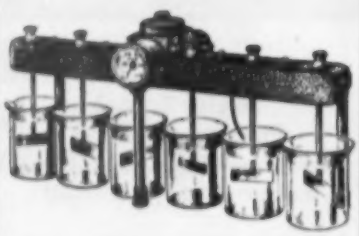

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added to the line. Tables of dimensions, weights, performances, mountings, pipe friction tables, and a typical pumping problem with its solution completes the bulletin.

Rotameter Kits

931

Brooks Rotameter Company, Lansdale, Pa., has just released an 8-page bulletin on **Rotameter Kits** for use in laboratory, field or pilot plants.

The bulletin includes pictures of all models, design and construction details, capacity charts, etc. Guaranteed interchangeability feature of the Brooks Tru-Taper precision bore Rotameter tube, details regarding better than 20-1 flow ranges provided by dual-float principle with Accura-Density metering floats, and other important technical information is graphically presented.

Models described include single meter Full-View and Sho-Rate kits; high pressure kits with gage glass construction; triple meter kits; multi-tube units in single meter body; all glass meters with a variety of connections; and a high capacity kit.

Wellpoint Catalog

932

John W. Stang Corporation, New York, N. Y., has available a 98-page catalog on the **Stang Wellpoint System.**

The catalog graphically presents every type of below ground water excavating problem that is likely to be encountered. Sixty-nine pages are devoted to typical case-history solutions, briefed for quick reading, and amply illustrated with pertinent on-the-job photographs.

The Stang wellpoint system for providing engineering analysis, overall service and field supervision is also explained.

Keeping Equipment Clean

933

Hall Laboratories, Inc., Pittsburgh, Pa., has just released a 6-page folder on **Keeping Equipment Clean.**

Pointing out that industry annually spends millions for repairs and maintenance, the new literature mentions trouble spots that can cause failures and enforced shutdowns in apparatus using water.

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The ideal solution is proper water treatment to prevent deposits and corrosion products from accumulating in the first place, the booklet observes. Several examples are also given where special problems were solved through an experienced water engineer's authoritative cleaning suggestions.

Adjustable Speed Drive

934

General Electric, Schenectady, N. Y., has just published a new 2-color bulletin on the company's general-purpose, full-wave, **Thymo-trol Adjustable-Speed Drive.**

The 8-page publication cites in detail the drive's simplicity of operation and economy. Featuring several industrial applications, the bulletin emphasizes the unit's printed control circuits.

Rubber-Seated Butterfly Valves

935

Builders-Providence, Inc., Providence, R. I., has issued a four-page color bulletin on its **Tight-Closing Rubber-Seated Butterfly Valves,** Model BV.

In addition to photos and drawings of Builders Butterfly Valves there are major sections on valve operators, a description of butterfly valve components, sizes, pressures, and velocities.

The standard design of the Builders Butterfly Valve meets all American Water Works Association (AWWA) Specifications on tight-closing butterfly valves and has the advantages of extra sturdy construction, easy operation, tight closure together with throttling, and a long life of trouble-free performance in a great variety of installations.

Flow Measurement In Sewage Works

936

Builders-Providence, Inc., Providence, R. I., has reprinted an article by Walter H. Brown and George E. Symons entitled **"Flow Measurement in Sewage Works."**

Complete with photos, tables and easy-to-read flow diagrams and dimension sheets, this twenty-page reprint is in three chapters: (1) Fundamentals, (2) Principal Devices Used and (3) Secondary Instruments, Controls, Operation, and Maintenance.

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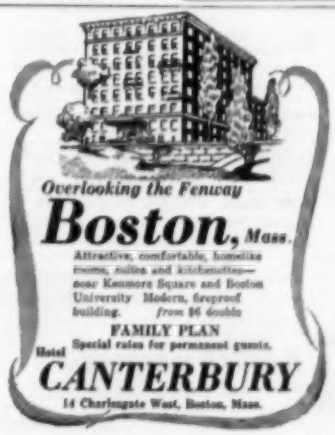
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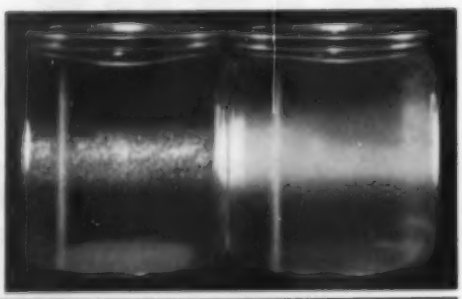

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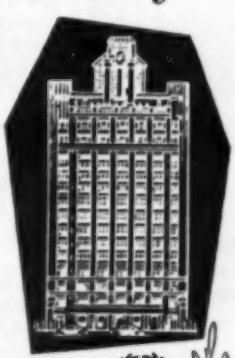

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INDEX TO ADVERTISERS

A

Airkem, Inc. 18A
Albright & Friel, Inc. 143A
Alvord, Burdick & Howson 143A
American Water Softener Co. 135A
American Vitrified Products Co. 53A
*Anthracite Equipment Corp. 140A

B

Badger Meter Mfg. Co. 19A
Baffa, John J. 143A
Baker, Jr., Michael 143A
Bernard Electric Co., Ernest 140A
*Bethlehem Steel Company 55A
Betz, W. H. & L. D. 143A
*B-I-F Industries, Inc. 110A-142A
Black & Veatch 143A
*Blackburn-Smith Mfg. Co. 134A
Bogert Associates, Clinton L. 143A
Bowe, Albertson & Associates 143A
Buck, Seifert and Jost 143A
Bucyrus-Erie Company 114A-115A
Buffalo Meter Co. 25A
*Builders-Providence, Inc. 110A-142A
Burgess & Niple 143A
Burns & McDonnell 143A
Byers Company, A. M. 52A

C

Calgon, Inc. 32A
Camp, Dresser & McKee 143A
Capitol Engineering Corporation 143A
Cast Iron Pipe Research Ass'n. 36A-37A
Centriline Corp. 126A
*Chain Belt Co. 49A
Chester Engineers, The 143A
*Chicago Bridge & Iron Co. 9A
*Chicago Pump Company 107A
Climax Engine & Pump Mfg. Co. 8A
Clow & Sons, James B. 51A
Columbia Southern Chemical Corp. 56A
*Combustion Engr. Co. 22A
Consoer, Townsend & Associates 143A
Continental Steel Corp. 136A
Cotton, Pierce, Streander, Inc. 143A
Crane Co. 34A

D

Darling Valve & Mfg. Co. 38A
DeLaval Steam Turbine Co. 12A
DeLeuw, Cather & Company 143A
De Zurik Shower Co. 134A
*Dorr-Oliver, Inc. ..... Third Cover
Dresser Manufacturing Div. 6A-7A

E

Eddy Valve Co. 42A
Ellis & Ford Mfg. Co. 138A

F

Fay, Spofford & Thorndike 143A
Finkbeiner, Pettis & Strout 143A
*Fischer & Porter Co. 35A
Flexible, Inc. 112A
Ford Meter Box Co. 132A
Freese, Nichols & Turner 143A

G

Gannett Fleming Corddry and Carpenter, Inc. 144A
General Electric Co. 28A-29A
General Filter Co. 111A
Gilbert Associates, Inc. 144A
Glenfield & Kennedy 24A
Glace & Glace 144A
Greeley & Hansen 144A

H

Hagan Corp. 54A
Hamilton-Kent Manufacturing Co. 16A
*Hardinge Company, Inc. 131A
Havens & Emerson 144A
Hayden, Harding & Buchanan 144A
Hazen & Sawyer 144A
Healy-Ruff Company 136A
Hersey Manufacturing Company 23A
Homelite Corp. 3A
Hotel Canterbury 142A
Hotel Carteret 145A
Hotel Tatem Surf Club 145A
Hydraulic Development Corp. 141A

I

Iowa Valve Co. 44A
Industrial Chemical Sales 31A
Infilco Inc. 109A

J

James & Baxter Associates, Inc. 144A
*Jeffrey Mfg. Co. 26A
Jennings-Lawrence Co., The 144A
*Johns-Manville 113A
Jones, Henry & Williams 144A

K

Keasby & Mattison Company 43A
Kennedy, Clyde C. 144A
Knowles, Inc., Morris 144A
Koppers Co., Inc. 123A

L

Le Roi Div. 33A
*Leopold & Co., Inc., F. B. 40A
Leupold & Stevens Instr. Inc. 121A
*Link-Belt Company 15A
Lock Joint Pipe Company ..... Second Cover
Lockwood Greene Engrs. Inc. 144A
Lozier Co., Wm. S. 144A

M

*M & H Valve & Fittings Co. 128A
Metcalf & Eddy 144A
Minneapolis-Honeywell Reg. Co. 47A
*Mueller Company 41A

N

*Natl. Water Main Clean. Co. 124A
*Neptune Meter Company 60A
Niagara Alkali Company 45A
Norwalk Valve Co. 138A
Nussbaumer, Clarke & Velzy, Inc. 144A

O

Oliver Corp. 17A
*Omega Machine Co. 30A-59A

P

*Pacific Flush Tank Company 39A
Parsons, Brickerhoff, Hall & MacDonald 144A
Pennsylvania Salt Manufacturing Co. 119A
*Permutit Co. 4A
*Philadelphia Quartz Co. 142A
*Phipps & Bird, Inc. 140A
Pirnie Engineers, Malcolm 144A
Pitometer Associates, Inc., The 144A
*Pittsburgh Coke & Chemical Co. 21A
*Pittsburgh-Des Moines Steel Co. 27A
*Pollard Co., Inc., Jos. G. 20A
Portland Cement Ass'n. 58A
Pratt Co., Henry 137A
Presstite Engr. Co. 117A
*Price Bros. Company 127A
Proportioneers, Inc. 118A
Purcell, Lee T. 144A

R

*Rensselaer Valve Co. 122A
Reliance Chem. Co. 136A
Riddick, Thomas M. 144A
Robert and Company Associates 144A
*Roberts Filter Co. 138A
Rockwell Mfg. Co. 57A
Rockwell Co., W. S. 125A
Roots-Connersville Blower Division 129A
Roger Fdry. Co. 141A
Russell and Axon 144A

S

Simplex Valve & Meter Co. 133A
Sirrine Company, J. E. 144A
Skinner Company, M. B. 138A
Smith & Associates, Benjamin L. 145A
*Smith & Loveless, Inc. 116A
Smith Co., S. Morgan 46A
*Smith Mfg. Co., A. P. 48A
Spanski & Williamson 145A
Standard Dry Wall Products Co. 139A
Stanley Engineering Company 145A
Stilson & Associates, Alden E. 145A

T

*Tennessee Corporation 130A

U

Uhlman & Associates 145A
U. S. Electrical Motors Inc. 108A
*U. S. Pipe & Foundry Co. 13A

W

*Wallace & Tiernan, Inc. ..... Back Cover
Washington Aluminum Co. 140A
Wertz Engineering Co., Inc. 145A
Westinghouse Electric 10A-11A
Weston, Eckenfelder and Hood, Inc. 145A
Weston & Sampson 145A
C. H. Wheeler Mfg. Co., Div. of Economy Pumps 120A
Whitman & Howard 145A
Whitman, Requardt & Associates 145A
Wood Company, R. D. 50A
*Worthington Corp. 14A

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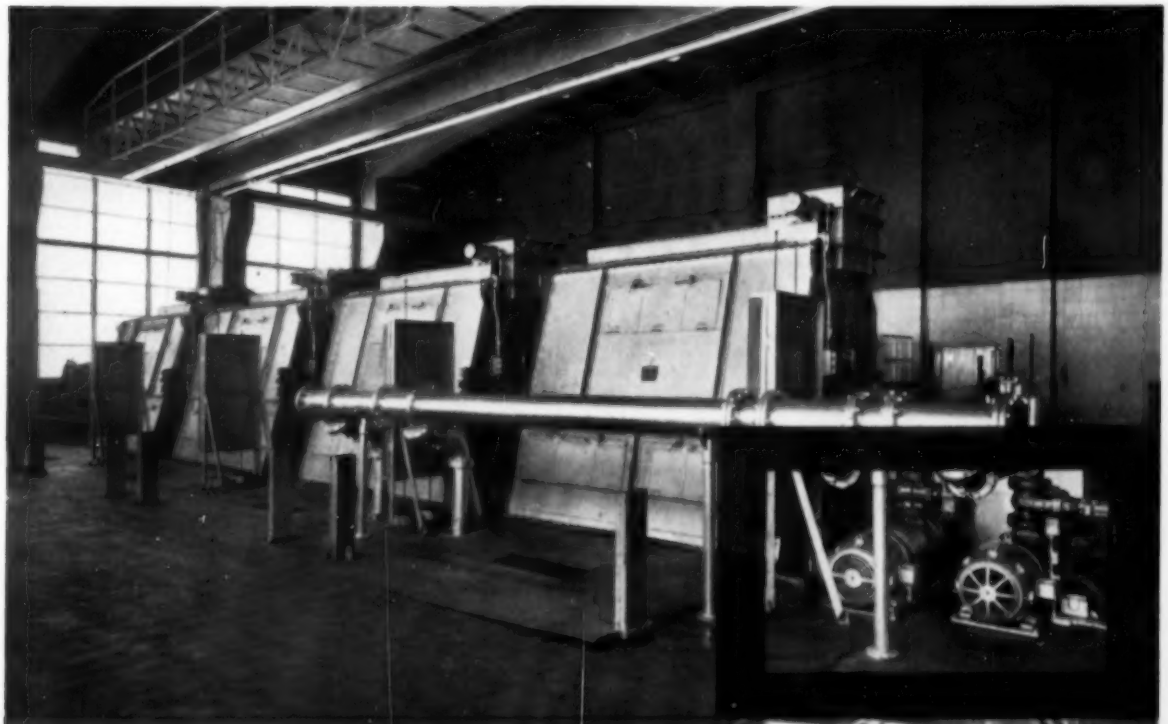

General view of screen room at Hyperion with Type S Screens at left and Disintegrators at right.

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Closeup of Disintegrators. Units were added to existing screening installation without expensive structural alterations.

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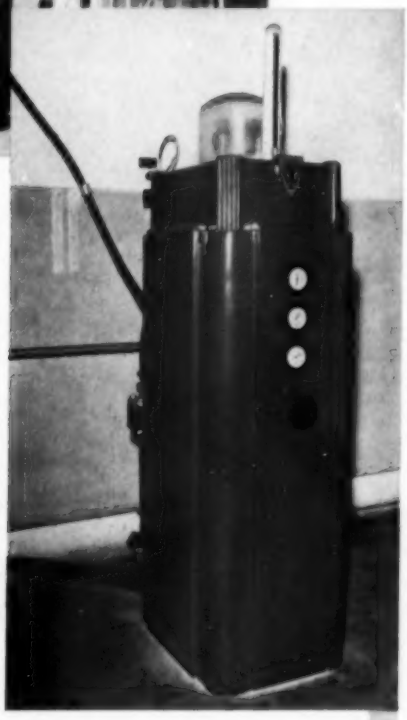

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